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ABSTRACT

Presented is a summary of an environmental science workshop for pre-service elementary teacher education held at Nairobi, Kenya. Workshop objectives include: (1) to adapt existing teacher training curricula to the requirements of an environmentally oriented curriculum of primary schools in Africa; (2) to highlight innovations in environmental science education teacher training; (3) to provide guidelines for future programs in environmental science education; and (4) to plan for collaborative action among participating countries. Included are addresses by speakers, country reports, summaries of workshops, working group reports, and working group summaries. (SL)

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REPORT OF A WORKSHOP ON
ENVIRONMENTAL SCIENCE EDUCATION

JULY 1974 NAIROBI - KENYA

ENVIRONMENTAL SCIENCE EDUCATION FOR PRE-SERVICE PRIMARY TEACHER EDUCATION

UNICEF/SEPA/UNESCO COOPERATION IN EDUCATION

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FUNDS FOR PARTICIPANTS WERE PROVIDED BY U N I C E F. CONSULTANTS WERE PROVIDED BY S E P A, THE BRITISH COUNCIL, U N E S C O, AND THE FORD FOUNDATION. CONFERENCE ROOM FACILITIES WERE PROVIDED BY K N U T, U N E S C O AND K I E.

IDEAS EXPRESSED IN THIS REPORT, EXCEPT FOR OFFICIAL STATEMENTS BY UNICEF AND SEPA, REPRESENT THE VIEWS OF PARTICIPANTS ATTENDING THE WORKSHOP: THEY DO NOT NECESSARILY REFLECT THE OFFICIAL POSITIONS OF THE SPONSORING AGENCIES.

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I INTRODUCTION

Upon request by the Science Education Programme for Africa (SEPA) (acting on behalf of African member States), UNICEF agreed to sponsor, through UNICEF members, two participants each from sixteen Anglophone African States to a Workshop on Environmental Science Education for Pre-service Teacher Education in Africa. The Kenya Institute of Education agreed to host the Workshop to be held during 19th to 29th July, 1974. Also upon request, UNESCO agreed to provide funds for the running of the Workshop and for one consultant; the British Council and the Ford Foundation agreed to provide one consultant each. Four African consultants were provided by SEPA utilising a grant from Education Development Center of Newton, Massachusetts.

Of the sixteen invited African States, fourteen sent participants. The participants were specialists in environmental science teacher education or educational planners attached to national curriculum development institutions.

The objectives of the Workshop were:-

- To adapt existing teacher training curricula to the requirements of an environmentally oriented curriculum of primary schools in Africa;

- To highlight innovative teacher training programmes in environmental science education;

- To provide guidelines for future programming activities in the entire field of environmental science education to save present and future generations from poor health and nutrition due to environmental mismanagement;

- To evolve strategies for the maintenance of enduring practical linkages between environmental science teacher training programmes and the needs of the individual communities they serve;

- To draw up a plan for collaborative action among participating countries.

Activities during the Workshop included the opening speeches by the Hon. Mr. P. Mbai, Assistant Minister for Education (Kenya) and by Dr. N.H. Ayodele Cole, Chairman of SEPA. The Keynote Address was delivered by Hon. W.O. Omamo, Minister for Natural Resources (Kenya). Other activities were reports in plenary session by each participant, exposition of ongoing critical and innovative programmes to counteract man's misuse of his total environment, group work on special aspects of the Workshop and visits to educational institutions as well as selected natural and man-made environments requiring special attention.

The four working groups established dealt with the preparation of guidelines for future activities at the primary and teacher preparation levels from the following viewpoints of environmental science education:-

- Gaining scientific knowledge about the environment.
- Using the environment to develop certain intellectual scientific skills as well as practical skills, and other benefits.
- Identifying and solving problems of values, practicality and safety in man's interaction with the environment.
- Translation of guidelines into action on a Pan-African basis.

Each group was provided with the following guidelines:-

General:

- African definition of the problem.
- Development of local, indigenous expertise in identifying and solving environmental problems.
- Programmes for children after primary school with respect to employment, further education, earning a living and generally being a good, useful citizen.
- Cognisance of different countries' socio/economic/political philosophies.
- Harmonisation of educational programmes with the language of instruction.

Specific:

- Examination of existing materials and approaches.
- Recommendations on adoption, adaptation, supplementation or substitution in existing materials and approaches.

The Workshop was opened by the Hon. P.N. Mbai, M.P., Assistant Minister for Education, and Mr. H.J. Kanina, Director of Education (Kenya) served as Chairman of the Opening Ceremony while Mr. I. Hunja, Assistant Director of Education (Inspectorate), was Chairman of the other sessions. The final session was chaired by Mr. A.N. Getau, Chief Inspector of Schools (Kenya). The Workshop was also addressed by Mr. B. Jones, Director of UNICEF - Eastern Africa Region.

The Kenya Institute of Education carried out all the local arrangements with Mr. M.B.R. Savage heading the service section. Profession E.A. Yoloye of the University of Ibadan served as the professional linkman for the Workshop.

While each working group had its own recorder, Mrs. Mandisi Vanqa, one of the Botswana participants, served as Rapporteur General.

II OPENING CEREMONY - Summary

The Opening Ceremony of the Workshop was held at the Conference Hall of the Kenya National Union of Teachers. Mr. H.J. Kanina, Director of Education in Kenya served as Chairman.

The Hon. P.N. Mbai, M.P., Assistant Minister for Education, gave the welcoming address. He stated that this Workshop "represents a precedent in the history of International co-operation" in that UNICEF and UNESCO, "the two giants in International co-operation", have combined to support "an infant and African organisation in the field, namely SEPA". Before giving a brief background of the Science Education Programme for Africa, the Hon. Assistant Minister praised SEPA for having established itself in only a few years as a relevant and effective Pan-African institution "promoting innovative and truly African programmes in education".

The two-fold task of SEPA was outlined. One part is the promotion of excellence through exchange of experienced manpower and information among African States. The second part serves to identify priority areas in science education in Africa and to initiate development programmes in these areas. An example of this type of programme is (the) International Centre for Educational Evaluation at the University of Ibadan in Nigeria - the Centre came into existence through a tripartite partnership of SEPA, the University of Ibadan and the Carnegie Corporation of New York.

The Hon. Assistant Minister went on to observe that Africa is faced with the problem, "or rather conglomeration of problems", of how best to exploit her natural resources. The purpose of the Workshop, he further stated, is to explore and devise fruitful pathways for the preparation of present and future generations, not merely to cope with rapid changes but also to contribute constructively to the wise utilization and management of the human environment. The critical factors in this venture are the teacher and a powerful environmental approach that builds from the ordinary man's point of view.

In conclusion, the Assistant Minister said Africa has a long and distinguished history of living with her physical environment and of adapting socially without bringing about deleterious effects on man and his environment. But problems of rapid change, a technology-based development and of hunger and poor health have strained the traditional approaches. "To find solutions to these problems I welcome the delegates from Botswana, Ethiopia, The Gambia, Sierra Leone, Swaziland, Ghana, Lesotho, Uganda, Somalia, Tanzania, Liberia and Zambia as well as the lecturers and students on whose shoulders the task will ultimately fall".

In an introductory speech, Dr. N.H. Ayodele Cole, Chairman of SEPA, referred to the close working relationship of SEPA with UNICEF and UNESCO from the very beginning. He emphasized that the SEPA's development activities have always been oriented toward the preservation and promotion of good quality of the environment. Both the content and style adopted in the developed instructional materials related directly to the needs of the African child

and of his environment. With this Workshop, SEPA is initiating an intensive environmental science education programme with special emphasis on the pre-service education of teachers.

Dr. Cole further stated that the lack of conservation measures has lead to "uncontrolled exploitation of our natural resources, unrestricted urbanisation and ineffective population control" and has created stresses on the environment evidenced in pollution of the "air we breathe, the water we drink and the food we eat". An integrated education approach is imperative before a meaningful amelioration can result. He concluded by saying that one of SEPA's objectives is to engender in the African population a constructive awareness and consciousness of the total environment.

The observation that "the study of the environment in Africa has always been an imperative issue in education was made by Mr. B. Jones, Regional Director of UNICEF (Eastern Africa Region) in a statement distributed to the participants. He went on to say,"I do not mean to say it has always figured as part of the formal school curriculum. Unfortunately, it has not. But in traditional education - the transmission of skills and knowledge from generation to generation by the family, the tribe and the community - what we would today call "environmental studies" have always played a major role.

UNICEF's concern is characterised by a desire to assist countries to meet the needs of their less fortunate children in fields of health and nutrition and to prepare their children for active and useful lives. While transfer of technology has benefitted millions of children, Mr. Jones stated,UNICEF has become increasingly convinced that to meet the needs of children in developing countries, "local solutions must be found specifically adapted to local needs and conditions, and they must be developed by local people".

Mr. Jones further observed that health and nutrition are basically environmental matters. "They involve man's relation to soil, water, climate, pathogenic organisms, plants, animals - a whole host of ecological factors, with man's own labour and intelligence entering to a large degree into the equation, too".

In conclusion, Mr. Jones stressed that in the final analysis progress in environmental science will depend mainly on the efforts of village people themselves through a better understanding of their relationship with their natural environment. Their children and grandchildren, thanks to science education, will be able to understand their environment in a way that will enable them to lead healthy and prosperous lives.

Delivering the Keynote Address, the Hon. W.O. Omamo, Kenya's Minister for Natural Resources, stated that environmental education connotes a whole complex of relationships between an individual, his society, the physical environment and the constantly changing dynamic equilibrium between them. He stressed that "the individual must be educated in a way that is sympathetic to his deep emotional and cognitive structures so that he remains confident in himself and his ability to intellectually solve his problems. He must be educated in a style and manner that is sympathetic

to and reinforces the support he obtains from his immediate society and culture. A man alienated from his society is lost".

Proceeding, the Hon. Minister urged that, while the individual is undergoing his education, a "regard for the wholeness and subtle interplay between the individual, his society and his physical environment" must be maintained.

Technology should be used judiciously to explore fruitfully alternative futures. One desirable future is of a world rid of the evils of poverty, ignorance and disease. The Minister announced to the participants that we in Africa have to identify and define our own environmental problems. "Indeed, for countless years", he said, "the people of Africa lived in a state of remarkable harmony with their environment. Social structures and customs supported the population. Patterns of land utilization, including shifting cultivation, never seriously depleted the soil and left ample time for recovery. Technology, though deceptively simple, was very effective". But since Africa has become part of a world community, there has been an overflow of problems from other continents and as a result formal and informal educational structures began to ignore the customs and practices that held African communities in good stead for centuries. The Minister concluded by saying that now the time has come for our educational planners to realise that our problems and their solutions are better appreciated when they are recognised by the people themselves. The greatest problem facing man is man himself and the solution of that problem is in man's hands.

Dr. H.M. Dyasi, Executive Secretary of SEPA, delivered the vote of thanks to the Minister for his inspiring speech. He also thanked the International organisations which combined to make the Workshop a reality. Not least was the magnificent response of the African governments themselves when SEPA asked for participants to this Workshop.

III-1 SEPA STATEMENT by Dr. H.M. DYASI - Executive Secretary of SEPA

When representatives of African States agreed in 1960 on the utilisation of science to change the African people's point of view from a colonial orientation to an abiding faith in our capability to make wise decisions about our lives and our environment, they ushered in environmental science education. The idea experienced its first practical tests in Nigeria and in Kenya in 1964 and was crystallised at a conference of representatives of some African States in Kano (Nigeria) in 1965 by the formation of the African Primary Science Programme (APSP). The APSP has been succeeded by the Science Education Programme for Africa (SEPA).

Through a series of workshops, seminars, publications and films, the APSP and SEPA have translated the original idea into programmes of action aimed at developing young people to become acutely sensitive to the effects of their actions in the total context of their environment. To achieve this objective SEPA stresses the following points:

- First-hand familiarity with a variety of biological, physical and man-made phenomena in the world around the child.
- Development of "interest in further exploration", and wise management of that world.
- Nourishment of the ability to find out on one's own - "to see problems and to be able to set about resolving them".
- Development of confidence in children "in their own ability to find out for themselves and do things for themselves".
- Development of an "ability to share in a common development of knowledge through collaborating on problems, telling, listening and discriminating use of second-hand sources".

These points imply a child-focussed environmental approach to the learning of science and an overall adaptation of school experiences to the local environment and to the intellectual, emotional and social aspects of the African child's life. What we are talking about, then, is man as an integral part of the environment, affecting it in a variety of ways and he, in turn, being affected in a variety of ways by the influences of the environment.

Meaning of Environmental Science

As we make young people aware of their place and role in their environment, we employ environmental science in its very broad meaning. There are those aspects which are termed ecology, geology, etc. and which seem to be accepted as science. There are other aspects which deal with the use of knowledge gained from these sciences - utilisation of land and water resources, use of fertilizers and pesticides, creation and destruction of human settlements, etc. There are still other aspects such as historical and cultural undergirdings of man's view and treatment of his environment - the local and national ethics as well as the local traditional structures and customs.

All these aspects combine to bring out the totality of environmental science and its intimate relationship with the local community. From this view grows the notion that there are no universal solutions to many environmental problems. Solutions for such problems must come from within the societies concerned. Yet, in a paradoxical way, all environmental problems are of a global concern in that mismanagement in one part of the world affects other parts of the world.

Environmental Science and Education

The place of education is clear and difficult. I am not going to describe it at this time. However, while environmental science describes the state of affairs (past, present and likely future), education must equip us with the necessary skills to make rational decisions about the environment and those decisions must be manifest in rational actions by each member of the society. The requisite actions are essentially a synthesis and valid evaluation of both scholastic and cultural knowledge and practice. That is the clear place for education. The difficult part is, how do you do it and how do you know you are doing it and doing it well?

There are questions relating to:-

- the curriculum - its flexibility and degree of integration of knowledge;
- the education of teachers - development of an appropriate style, content and practice;
- linkages between school and community;
- out-of-school education;
- the complete education of young people during the first four years of school - young children have their own ways of viewing things, and they do not recognise compartmentalization of knowledge.

Before I outline the role of this workshop, I would like to refer to other activities which have particular relevance to our task:

- In 1971 UNICEF and UNESCO held a Workshop for policy makers from your countries. They made recommendations charging professional educators with the responsibility to develop creative programmes to accelerate integrated science education.

- Soon afterwards, still in 1971, UNICEF and UNESCO held a Workshop for professional educators to take action on the recommendations of the policy makers. They outlined needed action in four areas, viz. clarification of the philosophy of environmental science education to serving teachers, curriculum development, development of instructional materials and the pre-service education of teachers.

- Also in 1973, SEPA held a four-week workshop focussing on the pre-service education of teachers for environmental science education. Early ideas were developed and illustrated focussing on the goals of pre-service science teacher education, studying the environment and educational evaluation.
- During 1974 SEPA developed a handbook for teachers of environmental science. Extracts will be available for the participants.
- In February, 1974, SCOPE and UNEP held a seminar on environmental science. They also dealt with education and suggested that concerted work must be done on curriculum revision at all levels, an appropriate style of teaching must evolve, and means of motivating students to adopt a constructive environmental ethic should be devised.
- On 19th July, 1974, SEPA and UNESCO concluded a two-week workshop on environmental science education for primary schools in Francophone West Africa. Recommendations of that workshop stress the importance of relevant content and methodology, education of teachers and the development of instructional materials.
- During August, 1974, there will be a workshop on environmental education methodology, introducing the concept of "total education in the total environment" in methodology courses for teachers. UNESCO and UNICEF will also hold a workshop on basic education.
- In 1975 SEPA hopes to hold a workshop on environmental science education for francophone African countries.

All of these activities will help provide basic information for the Conference on Applied Science and Technology in Africa (Science Education) planned for 1976. The present workshop, therefore, is a half-way mark and is pivotal in that it will be the first to deal completely and practically with environmental science education for pre-service teachers. It will also be the first to approach the problem in terms of making children the focal point in teacher preparatory programmes in this area of study.

The Scope of this Workshop

- To take a look at teacher preparatory programmes in environmental science education;
- to discuss in detail some specific aspects of innovative projects in this field;
- to develop plans of action for the next two years in those aspects deserving priority attention;
- to describe as completely as possible implications for education in the primary cycle and at the teacher training level, for development of instructional materials, educational evaluation and educational administration.

- to make suggestions about areas of knowledge which do not appear to be sufficiently developed for purposes of programming in environmental science education, e.g. African indigenous approaches to environmental science;

This then is a workshop at a half-way point in our long march towards making the African indigenous culture, mores and enduring and useful structures - the matrix of environmental science education in Africa.

III-2 COUNTRY REPORTS - Summary

EDUCATIONAL STRUCTURE

Country	Primary Yrs.	Junior Secondary Yrs.	Senior Secondary Yrs.	A.Level Yrs.	University Yrs.
Botswana	7	3	2		4
Ethiopia	6	2	4 Agric. Commercial Industrial, Tech.		
Ghana	6	3	3	3	3 or 4
Kenya	7	4	-	2	3 - 5
Gambia	6	4 or 5 Grammar	-	2	
Lesotho	7	3	2	-	4
Sierra Leone	7	(5	)	2	3 or 4
Uganda	7	(4	)	2	
Swaziland	7	3	2		3 - 5
Somalia	4 elementary	4 intermediate	4 secondary		
Tanzania	7	4	2	2	3
Liberia	6	3	3	-	4
Zambia	7	3	2	-	4 - 7
Mauritius	7	(5	)	2 or 3 HSC Cambridge	-

Structural Relationship of Primary Teacher Training with Other Institutions

Country	Entry Qualifications	Responsibility of Curriculum Development & Certification
Botswana	After 3 years Junior Secondary it is a 2 year training course	Ministry of Education and Curriculum Development team.
Ethiopia	After 12th Grade or 6 years Secondary education, the course is 12 + 1 year; 11 + 1 year or 10 + 2 years.	Ministry of Education
Ghana	After 'O' level or 5 years Secondary education, it is a 2 year training course	Ministry of Education
Kenya	After 4 years or 2 years Junior Secondary,duration 2 years	Kenya Institute of Education
Gambia	After 5 years Senior Secondary; duration 3 years	Ministry of Education
Lesotho	After 3 years Junior Secondary it is a 2 year training course	Ministry of Education and Curriculum Development team
Sierra Leone	After 'O' level or 5 years Secondary Education; duration 3 years	Institute of Education (University of Sierra Leone)
Swaziland	After 3 years Secondary; duration 2 years	Ministry of Education
Somalia	After 8 years primary or 9 yrs primary; duration 8 years - 3 years 9 years - 2 years	Ministry of Education
Liberia	After 3 years Junior Secondary duration	Ministry of Education
Uganda	After 7 years Primary; duration 4 years	Ministry of Education
Tanzania	After 7 years primary duration varies - 2 yrs; 3 yrs. (This year those who did not do well in their GCE, duration 1 yr.	Ministry of Education
Zambia	After 3 yrs. Junior Secondary and 2 yrs. Senior Secondary; duration 3 yrs.	Ministry of Education

General Objectives of Teacher Training Curriculum

Botswana: To improve the quality of teachers by:

- raising the entry qualifications of pre-service teachers; and
- conducting inservice courses for serving teachers.

To develop a curriculum that is child-centered with the environment as the source of materials.

Ethiopia: To produce competent teachers with a thorough understanding of the child.
To improve curriculum for pre-service teachers in order to enrich their academic background.
To conduct workshops and in-service courses for serving teachers.

Ghana: To produce teachers that will make education "Child-Centered", using the child's own environment as material for study.

Kenya: To train teachers that will be able to develop the child's potential abilities to their maximum.

The Gambia: To provide teachers with sufficient skills, both practical and academic, to enable them to view the educational process as an integrated whole, influenced by and in turn influencing the local community and society at large.
To show the static/dynamic nature of society.

Lesotho: To improve the quality of teachers by raising the entry qualifications and up-grading serving teachers by conducting in-service courses.

Sierra Leone: To improve the quality of the teacher by organising a curriculum that is relevant to the attainment of professional and academic growth of the student teachers; and to present a methodology that is child-centered.

Swaziland: To produce better trained teachers to teach most subjects in the primary schools.
To up-grade and re-orientate practising teachers to the modern methods of teaching and the use of learning materials.

Somalia: To improve the quality of the teacher and to emphasize environmental study which focuses on developing their scientific information and attitude.

Liberia: To train student-teachers and re-train in-service teachers to have a thorough knowledge of techniques needed for working in a rural setting.
To prepare new materials relevant to Liberian society; and

to conduct research on specific goals of primary education and to determine the required skills, attitudes, concepts and strategies which will fulfil these goals.

Uganda: To develop an environmental-based curriculum and devise a methodology which will provide situations that will encourage reasoning and thinking by pupils and student-teachers themselves, using materials in their own environment to develop an awareness of opportunities for self-employment.

Tanzania: To reform the primary education system by placing emphasis on such knowledge and skills as may be useful in the development of a higher and happier standard of living in both rural and urban communities, through self-reliance and self-discipline. To train the student-teachers and serving teachers for this.

Zambia: To develop teacher training courses that focus on pedagogic techniques and teacher's personal education.

Objectives of the Environmental Science Education

Botswana: To familiarize the teachers with ways of learning science through active discovery and creative use of the environment.

Ethiopia: To provide a course that links the student with his or her environment.
To teach conservation, agriculture, health and respect of manual work.

Unique Features: There is no environmental science course, but a course entitled environmental studies which integrates rural science and social studies.

The integration is to be achieved between related subjects, selected topics or themes on these subjects, or between principles of education and teaching practice, and between content and subject methodology.

Ghana: To integrate science with other related subjects and make it as relevant and practical as possible and not to regard science as a body of knowledge merely to be handed down from one person to the other.

Kenya: To provide guide-lines for teaching science in elementary schools.
To develop and prepare programmes for pre-service and serving teachers.

Unique Features: The environmental science education programme is based on the APSP materials. As this discovery approach is demanding to teachers, an intensive pre-service and in-service programme is being followed.

The Gambia: Environmental Science Education programme is not yet in action. Plans are afoot for the future.

Lesotho: The objectives of the Environmental Studies group are:

- Using mainly the indigenous talent, develop open-ended units basing them on the Church, the locality, the farm, trade and justice.
- Develop primary school readers that will sensitize the child to some issues about the environment.
- Find ways and means of using indigenous expertise in schools.

Sierra Leone: To familiarize the student-teacher with experiences of the primary school child.
To know the physical and cultural environment in which both teacher and pupil live.

Sierra Leone
../cont.. To explore areas of knowledge relevant to the young primary school child.
To acquire adequate background knowledge relevant to the primary school programme.
To prepare the student-teacher to develop attitudes and intellectual and manipulative skills in his pupils.

Unique Features

- Quality of Staff: Science educators and curriculum specialists who are mostly graduates.
- Integration: of the sciences with environmental components of the cultural and physical location.
- Underlying Principles: The development of the child, familiarity and availability of materials and the nature of the local environment are all taken into consideration.
- Materials: Use of local materials and the local environment is emphasized. Instructional materials to enable this are developed.
- Teaching and Learning Principles: are based on individual interest and readiness.
- Evaluation: During science panel meetings of the Teacher Training Colleges reports are presented by each College which are discussed and evaluated by other members of the panel.

Swaziland: Environmental science education is not distinctly included in the current syllabus. Many components of environmental science are dealt with by the Ministry of Agriculture.

Somalia: Environmental science is partly integrated in the science programme and partly studied in the lower grades as nature study. A major objective is to improve the quality of the teachers and to emphasize environmental study which focusses on developing their scientific information and attitude.

Liberia: To develop the following skills: observation, measurement, communication, classification, inference and prediction, testing and questioning, experimentation and model development.
To develop scientific attitudes such as curiosity, persistence- honesty, suspended judgement, open-mindedness, critical mindedness and self direction.

Unique Features:

- to approach full integration of several units;
- to establish an Astronomy Club;
- to utilise fully the locally obtained materials;
- to teach units prepared at the institute.

Uganda: To educate the child wholly by educating his head, heart and hands, that is, in the thinking and reasoning, attitude and interest, and practical skills.

Tanzania: There is no environmental science programme as such but an integration of Mathematics and Science under the name Natural Sciences. The objectives of natural sciences are to develop the following skills: observation, measurement, inference and prediction, communication, experimentation, resourcefulness and creativity.

Zambia: To develop skills, desirable attitudes and critical thinking using the environment around the child as a source of material and knowledge.
To determine how man can effectively control and utilize his environment to his advantage.

Future Plans

Ethiopia: The Academy of Pedagogy has been established with the provision of education for teacher education in mind. Eight phases were proposed for the academy, namely:

- Preliminary phase
- Simulation and research phase
- Students intake phase
- Development phase
- Phase that deals with development of projects
- Phase providing an in-service education for teaching profession at both primary and secondary level.
- Phase which deals with evaluation of the Academy
- Phase in which the expatriate staff will be phased out.

Kenya: To strengthen the pre-service and in-service teacher education programme.
To organise workshops and seminars for field staff (Provincial Inspectors, Teacher Advisory Centres staff) and College tutors.
To develop programmes for Diploma, Undergraduate and Post-graduate course incorporating modern science education trends.
To expand the Teacher Advisory Centres and to streamline and improve their operations.

Ghana: Six specialist colleges were opened a year ago, specialising in Mathematics and Science. These, therefore, will look into the improvement of these two subjects.

The Gambia: Submission has been made to international agencies for help in the retraining of teacher educators. At the local level integration of education, agriculture, health and practical applications of experience gained is to be encouraged.

Lesotho: The Environmental Studies Group will:

- identify the skills that could be achieved or consolidated during the various activities;
- test its investigation and findings in the classroom situation using the children.

Sierra Leone: To continue further development of environmental science education.
To train teacher educators within the Faculty of Education of the University of Sierra Leone.

Somalia: Future plans for education in general:

Somalia ../cont..	- To expand the educational opportunities to enable a child to go from primary to intermediate school and, if possible, even through to secondary school. - "Nativisation of education" which is explained as meaning both content and the methodology of education should be geared to the needs of our societal and physical environment.
Liberia:	Development and implementation of a new science curriculum. Construction of demonstration schools. Strengthening the Mobile Teacher Training Units. In-service teacher training. Expansion of the campus facilities to increase its intake. Providing home-economics room, manual arts workshop, language laboratory and microteaching clinic.
Uganda:	To expand the environmental practical approach to all teacher training colleges by introducing new curriculum content, teaching methods and materials in primary schools and pre-service teacher training colleges.
Zambia:	To expand manpower resources both professional, technical and administrative. To develop locally-based materials for all levels of education.

IV SPECIAL REPORTS

Introduction:

Five reports on projects thought to have innovative characteristics relevant to environmental science education for pre-service teacher preparation were presented and discussed in detail.

The order of presentation was arranged in accordance with the stage of development of these projects. The project from Lesotho is an idea of a special environmental education committee and is not yet operational; the University of Nairobi project is in its pre-implementation phase; and the Sierra Leone and Mid-West State (Nigeria) projects are operational on a trial basis. The Namutamba project is fully operational and has recently been evaluated prior to implementation throughout the country.

Each project is described in full below:

ENVIRONMENTAL STUDIES IN THE PRIMARY SCHOOL (LESOTHO) : By T.S. Thelejane

The Environmental Studies Group:

Following the birth of the African Social Studies Programme in 1968, the Lesotho Social Studies Group was formed. It was composed of people from the University, the Ministry, a teacher training college, secondary schools and primary schools. At the same time an attempt to form a group to promote science education was afoot. Due to the shortage of manpower in Lesotho, the same people invited to form the above group were candidates. After scratching our heads a bit, we realised that both Social Studies and Science depend on the environment. We re-named the Lesotho Social Studies Group - the Environmental Studies Group. The focus from then henceforth has been on environmental studies.

Philosophy of the Group:

It should be recognised that people are the very centre of environmental studies. Whatever happens to the environment is due to man's positive or negative attitude. Perhaps the most important environment is man's mind and that is where activities should start. He must first respect himself to a degree of pride in what he is and wants to be. Naturally, a self-respecting individual will respect his immediate physical environment wnich, fortunately, is shared by the neighbour in the biblical sense.

The children must start as early as possible interacting with the environment positively if this is to be meaningful to them.

Children live and play nearer than other ages to the real environment. Their experiences of the environment are a great help in guiding and initiating students in the all important art of learning how to learn. It is not only relevant but educationally sound and economic to use the

physical environment for effective learning by young adults.

Objectives

- Using mainly the indigenous talent, develop open-ended units basing them on the Church, the locality, the farm, trade and justice.
- Develop primary school readers that will sensitize the child to some issues about the environment.
- Find ways and means of using indigenous expertise in schools.

Background Information

Some time towards the end of the first half of 1973 an informal discussion on how to continue to work with Experimental Schools took place between the Chief Education Officer, the E.O. (Maseru), the Inspector responsible for Experimental Schools and a Senior Lecturer in the School of Education. These discussions led to two-day monthly meetings organized for the eight schools which had gone through their cycle with the Durham Team. Each school was asked to send two teachers, who will on their return to schools in-service other teachers using the materials discussed during the two-day get-together.

The original idea was to decide, during the two-day workshop, on one or two units that will be tried during the following month. It was thought this would provide an opportunity whereby a number of people will be trying something of their own and they would also stand a better chance of comparing notes. The Inspector responsible for Experimental Schools would know what to expect when he visits these schools, and discussions between teachers and himself will therefore be more relevant.

The very first workshop indicated that our plans were too ambitious. It was discovered that the members of the workshop needed certain skills before they could embark on our ambitious plans. It was, therefore, decided to develop these skills while developing certain basic units such as the Church. In other words, in-service went hand in hand with development.

The whole of our operations in 1973 concentrated on the familiar cognitive domain. The plan is to move to the area of skills relevant to primary school children, based on our 1973 work. Later on we shall get to the field of cognitive styles most suitable for Lesotho children.

During our workshops, a number of important issues were discussed. The question of the objectives of primary education in operational terms was touched. Tentative statements were made. A question was raised as to whether it is necessary to have Science and Social Studies as separate subjects. Are they not part of knowledge the child should be encouraged to "discover" from the environment? By the end of the year the group was beginning to believe that the subjects at primary level should be shrunk to languages, mathematics and knowledge (Environment).

In view of the country wide end of primary school examinations, it was considered necessary that there should be some relationship between the environmental activities used by the various schools. Furthermore, the knowledge thus gained must introduce the child to his immediate future life, be it in the secondary institutions or out of them. If this transition is smooth, he is most likely to be in control of the rest of his future.

The Work Done to Date

So far everything is in rough form on loose papers packed in boxes. As already indicated above, we have been concerned with the tedious work of listing the facts that are considered by the Ministries as being important. Those that have definite statements on what they expect a child at the primary level to learn are Education (through its end of primary examinations), Agriculture and Interior (Chiefs). In addition to these facts are those we considered, through asking the child, as necessary to the citizen of tomorrow. Deliberately we worked hard to make sure that what is required by the Ministries will be a sub-set of the facts needed by the child. Time and time again it was found necessary to bend the views of a Ministry a bit.

Whatever we did was based on a master flow chart. This approach was encouraged by one of the participants who had previously attended a workshop in Botswana organised by the African Social Studies Programme. As a matter of fact in her school, almost every class has a flow chart of the work being done. When filling in details on the flow chart, thinking in terms of subject areas helped, specialists in various fields were quick to see possibilities. All the five areas selected, that is, the Church, the locality, the farm, trade and justice, were flow charted. In the following page is an example of one of these.

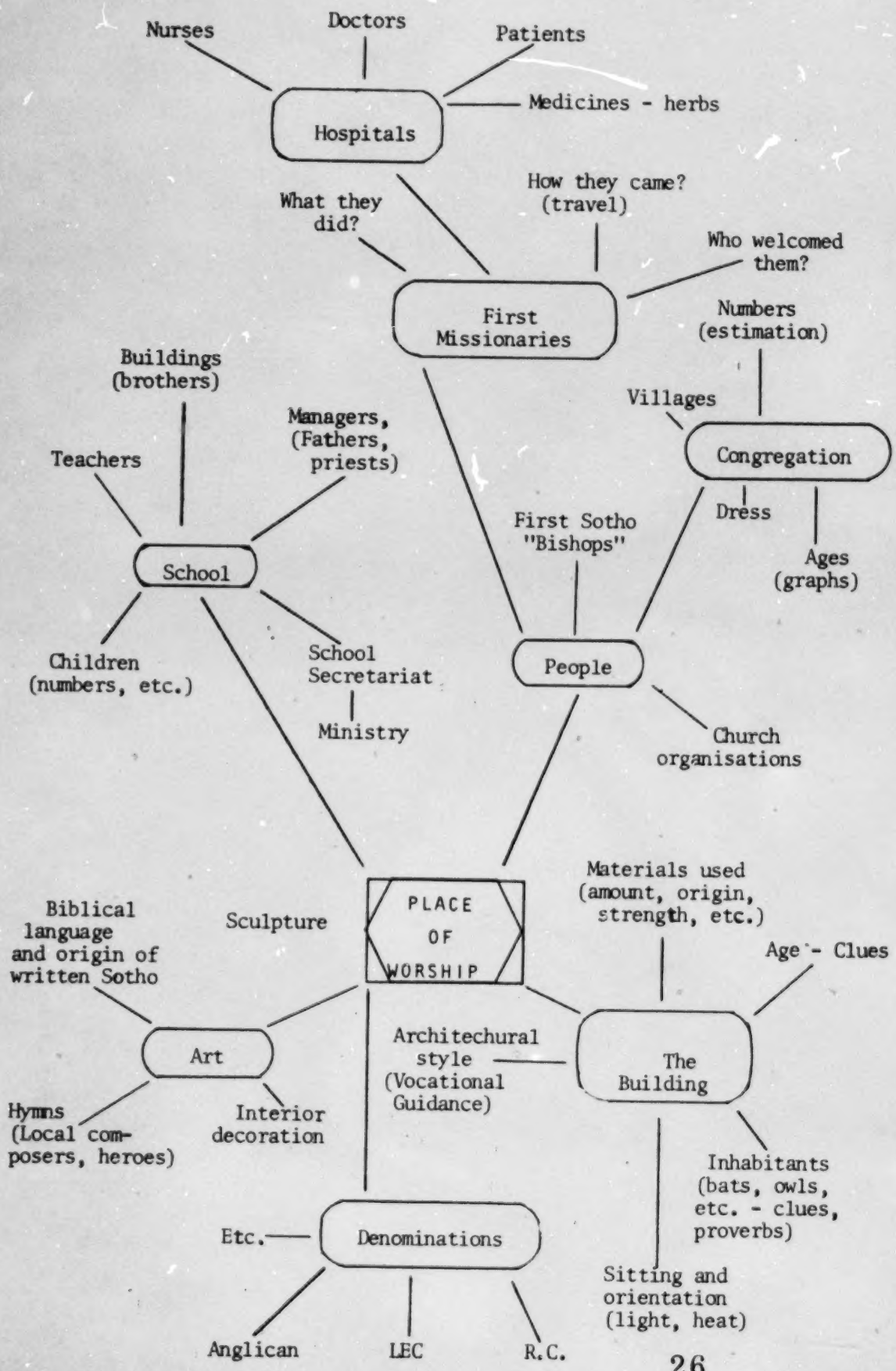
A programme of writing children's readers of about twenty pages has also been started, involving part-time students of the School of Education. Topics to be dealt with, hopefully, will be supportive to classroom activities. Topics being tackled are: "Why Girls Do Not Eat Eggs in Lesotho"; "The Queen That Ate Sorghum for Poison"; "Moeketsi, the 'Son' of Matholoana'"; etc.

Future

We still have to identify the skills that could be achieved or consolidated during the various activities. Once this is done we shall get to the most exciting stage - that of preparing to enter the classroom and ask the children once more if we interpreted correctly what they told us regarding their needs.

Afterthought

Purposely, we have 'over-planned' before going into the classroom so as to meet the examination menance half-way. Our country is party to a testing centre with Malawi, Botswana and Swaziland. Even parents know that 'COMPUTA' runs the examinations! We cannot ignore 'HIM'.


Nurses
Doctors
Patients
Hospitals
Medicines - herbs
How they came? (travel)
What they did?
Who welcomed them?
First Missionaries
Numbers (estimation)
Buildings (brothers)
Villages
Managers, (Fathers, priests)
Teachers
Congregation
Dress
First Sotho "Bishops"
Ages (graphs)
School
Children (numbers, etc.)
School Secretariat
People
Ministry
Church organisations
Materials used (amount, origin, strength, etc.)
Biblical language and origin of written Sotho
Sculpture
PLACE OF WORSHIP
Age - Clues
Art
Architechural style (Vocational Guidance)
The Building
Hymns (Local composers, heroes)
Interior decoration
Inhabitants (bats, owls, etc. - clues, proverbs)
Etc.
Denominations
Sitting and orientation (light, heat)
Anglican
LEC
R.C.

TEACHER CORPS : A PRACTICAL MODEL FOR TEACHER TRAINING
By Dr. J.O. Perry - University of Nairobi

International research indicates that the educational deprivation of rural children and adolescents in many parts of the developing world is even more serious than is generally assumed by educators. My observations of rural education in Africa - although admittedly limited - supports this sombre picture, not only with regard to primary education but in teacher training as well. As long as teachers remain the major instrument of intellectual and attitudinal development in these countries, commitment must be nurtured among both novice and veteran teachers to a bold, yet realistic vision of what they want their community and nation to become. Teachers must be prepared to undertake in conjunction with community and national leaders, the basic social and economic changes required to realize this vision.

This will require not only encouragement and latitude (and money) from the national government, but also fundamental changes in the attitudes of parents, teachers, and administrators toward education; i.e. to view education as learning, continuous learning, and not simply as schooling. I am very proud to note that my host country, Kenya, is progressing to a redirection of its resources to a democratically conceived mass learning system, designed for greater equality of opportunity and achievement to all young people - and especially for rural youth. The President's recent gift to the "wananchi" of universal primary education is right on time with the nation's development and is a commendable step to have taken.

It has been predicted that because changes in the status quo are extremely difficult, universal primary education will take generations to complete, perhaps, but whatever is achieved will occur only through the efforts of enlightened, well prepared decision makers in education .. and that includes teachers. Although a great deal of emphasis is being placed upon nonformal and informal approaches to mass education, I am of the opinion that these are clearly complementary and mutually reinforcing elements of the more formal aspects of education. I am a teacher educator in the formal system, and am guilty of a few biases in that direction. I view the restructuring of teacher training as prerequisite to the achievement of universal primary education. Educationists have outlined six basic areas considered to be minimum essential learning elements of children, which must be given high priority by any society guided by democratic ideals. I am intrigued by Phillip Coombes' description of minimal learning competencies in the field of science. He says that "each child should develop a scientific outlook and an elementary understanding of the processes of nature in his environment as they pertain, for example, to health and sanitation, raising crops and animals; nutrition, food storage and preparation, and to the environment and its protection".

Many children must and will achieve far more than this minimum in science education, of course. But this paragraph presents broadly the basic elements of science education at the primary level. It further suggests what the content and the strategies of teacher training must include in order for

teachers to evoke a response among children to scientific inquiry.

My concern today is to present an alternative model for primary teacher training which will facilitate the necessary linkage between content, methodology and interaction with the learning environment - including children.

The model I am presenting for discussion calls for a rather dramatic reduction of pre-service time on the college campus and an emphasis on in-service training at the primary school site - where children exist, where ideas and strategies can be tested in less than ideal conditions, where feedback is immediate and effective, and where revisions can be made and the recycling process begun. This model is called Teacher Corps, a national programme for teacher training; its content and processes are competency-based, and the school sites adapted for inservice training of teachers are called "portal schools".

Time will allow only a cursory description of these three concepts.

The Teacher Corps model developed in the United States in the mid-sixties in response to a national crisis in supplying qualified teachers to meet the demands for quality education from a rapidly expanding rural and urban society. When the major educational institutions of higher learning appeared apathetic or unable to meet this crisis, the federal government intervened to establish the National Teacher Corps.

The express purpose of Teacher Corps was to nationally recruit graduates of liberal arts colleges and to qualify them as teachers for culturally and economically impoverished areas of the nation. Several institutions were commissioned by the federal government to provide the training and to grant certification or degrees for these teachers. Although the programme was not specifically designed to increase the numbers of blacks and other American minorities in education, Teacher Corps soon proved an effective vehicle for this purpose. The training of minority teachers became a national policy.

Federal guidelines demanded that participating colleges employ the highest degree of innovation possible in content, teaching methodology, and skills development in order to fill vacancies without sacrificing quality. Thus, Teacher Corps became an instrument of institutional change, especially within Schools of Education, and instigated the development of experimental programmes which graduated the largest, most creative and dedicated cadre of young teachers the nation has ever known. Today, nine years later, this national programme in teacher education is still in force, now meeting special goals in education, e.g. bilingual education, special education for the handicapped, curriculum development projects, in-service programmes for teachers and administrators, etc. The graduates of Teacher Corps are greatly in demand for both urban and rural as well as the more affluent suburban schools of the nation. Research indicates that over 80% of these teachers remain in the field of education years after completion of their training. The National Teacher Corps concept seems to create a special commitment and dedication for teaching, which produces willing teachers even when teaching conditions are far from ideal.

I have been training teachers for over 27 years. I have had the good fortune over the past four years to administer Teacher Corps programmes for both rural and urban schools in the Southwestern United States. Perhaps the most challenging programme for me has been the training of mathematic and science teachers for Sierra Leone through the Teacher Corps model. It is the success of this experience which has convinced me of the adaptability of the Teacher Corps model for the training of science or primary teachers for the nations of Africa.

Teacher Corps projects currently serve in over 150 school districts, 5 prisons and 17 juvenile institutions. They operate in co-operation with 85 colleges and universities, 36 States of the United States, Puerto Rico and the District of Columbia. About half of these projects are in major cities while the rest are in smaller towns and rural areas including migrant camps, Spanish-speaking communities, Indian reservations and parts of Appalachia and the Ozark Mountains.

Very briefly, the programme which I directed for Sierra Leone involved the training of American teachers at the graduate level, all holding baccalaureate degrees in mathematics or science. They were recruited from all areas of the United States and given a one-year intensive graduate programme in mathematics and science content and teaching methodology before departure for Sierra Leone. Their preparation included also language and cultural training and internship in the secondary schools of Houston, Texas.

The project is three years in length, two years of which are spent in Sierra Leone with Peace Corps in active teaching and research in education. In its fourth year of operation, three groups are currently in service in Sierra Leone and a fourth is being prepared for both Sierra Leone and Ghana. The first group has just completed the Master's Degree in Education; the majority of the interns elected to remain in Sierra Leone for a third year. By all measures, including the incountry co-ordinator - Dan Chaytor, whom many of you know - this programme has proved to be highly successful in meeting its objectives.

My experience and research suggest that the Teacher Corps model is a viable alternative structure for teacher training in Africa, especially in meeting the needs of universal primary education. American students would not be used, of course; the interns would be your own nationales, perhaps chosen from among secondary leavers who for a variety of reasons have not entered the University or training colleges. These would receive a short but intensive pre-service programme at the university level in content, foundations and methodology. They would also receive language training and cultural training, since their internship may be in areas which are culturally different from their own and since teachers should be able to teach bilingually in English and the national language. Very importantly, credits earned by these interns would be acceptable toward continued study for a Bachelor's Degree in Education.

In essence, these interns would begin to teach children following 6 - 8 weeks of pre-service training; the in-service phase would require at least one year,

during which time they are also actively teaching. The qualification of these novice teachers would require considerable innovation in teacher training practices by participating institutions.

I am presenting the model in the context of Kenyan education, because I am more familiar with it than others - and also because I have a greater awareness of the particular problems it would solve in teacher education in this country. Please keep in mind that this is a federally-based project organised, funded and directed by the Ministry of Education. The actual training would be conducted by teacher training colleges and the University. In very simplistic terms, a National Teacher Corps Programme in Kenya would involve the following logistic and operational procedures:

1. The Ministry of Education would draft guidelines for teacher training, would obtain appropriation for operational costs of the total enterprise, and would establish budget limitations for each contract awarded to training institutions.

2. The University, training colleges and multi-purpose institutions would submit competitive proposals for NTC contracts specifying number of interns to be trained and including costing for both pre-service and in-service phases of the training programme. Each institution would outline innovations in the proposed training scheme, evaluation procedures and their system of quality control - all of which are major criteria for funding consideration.

3. Recruitment would be conducted by the Ministry together with the institutions approved for funding. The Ministry would determine the pool from which interns are to be selected, ie. primary school leavers, secondary leavers, or baccalaureate degree holders (if M.Ed. programme). Different institutions may be assigned different levels to train, depending upon the greatest availability of manpower. Each selected intern would receive a taxable stipend from the government throughout the total training period.

4. Interns would receive 6 - 8 weeks of intensive preparation on the campuses of the educational institutions involved. The course work during pre-service would consist of teaching methodology, foundations of education and primary content with emphasis upon science and inquiry methods.

5. Immediately upon successful completion of pre-service, interns would be assigned to schools in the local communities surrounding the institutions. A team of interns (usually 5 - 6 persons) would be assigned to a school with an experienced teacher (referred to as a team leader) who will share supervision of the internship programme for one academic year. During this period, the interns teach children daily under the guidance and supervision of the experienced teacher or team leader. Instructors from the training colleges and university are required to conduct regular in-service seminars at the primary school sites, which will be attended by the regular teaching staff and administrators of the schools. (This is the "portal school" concept, which I will explain in greater detail).

6. As a very important part of their training, interns are required to spend one-third of their time working within the local community to support and staff ongoing self-help programmes, to introduce or staff literacy programmes in English or the national language, to design recreational schemes, etc.

7. Upon completion of the total programme, interns are assigned permanent teaching positions throughout the nation or on a local basis. Depending upon their levels of entry into NTC, they may earn from the responsible institutions teaching certification and/or credits toward a college degree.

Recruitment for a second internship programme will already have begun by this time, and the process begins anew with an evaluation of guidelines, adequacy of funding, training procedures, quality of graduates, etc.

I do not propose to deal at this time with the matter of teacher training content - that is another full lecture, except to say that instruction is competency-based. One might define "competency-based teacher education" as a process in which competencies that teachers are to have upon completion of their studies are explicitly defined in behavioral terms at the beginning of their training. Each teacher is required to demonstrate these tasks at an acceptable level of performance before he is graduated from the programme. If, for example, one of the teaching competencies at the primary level is the ability to diagnose pupil learning, the student teacher or intern must first acquire sufficient knowledge of diagnostic techniques and procedures. He then practices these techniques in simulated or peer situations. First, he demonstrates in a simulated situation that he is competent; then he must successfully demonstrate these particular skills in teaching real children before he is declared a competent teacher.

In a competency-based teacher education programme, a student teacher's competence is not determined solely by his participation in course work or his ability to write an exam with honours. He must be able to translate his acquired knowledge into action as he interacts with children.

This means, further, that the instructional staff can no longer talk vaguely about what a good teacher should know or should be able to do - rather, each professor must clearly state at the beginning of his course the exact knowledge, skills and attitudes a student is expected to demonstrate at the culmination of his training. This process is tremendously challenging for both the instructor and the student, because the evaluation of the instruction and the assessment of the student's performance are so interdependent - professors' egos are very often bruised in the process. The important factor is that more competent and dedicated teachers are prepared by these means.

Those of you who are teacher educators will agree that the inservice phase of teacher preparation in traditional programmes is perhaps the most vague and loosely managed part of training. Sometimes this involves observation of regular teachers in the classrooms and little or no interaction with children. Sometimes it means 6 - 8 weeks of teaching experience in the schools -

perhaps in a classroom with a co-operating teacher, sometimes supervised by the instructor, sometimes all alone "hanging out there" all by himself, commiting every mistake known to teaching, but with no help or supervision or encouragement.

New teachers, highly skilled in pedagogy - sometimes more so than the regular teachers in the school - are generally forced to conform to the existing practices in the school. Novice teachers are therefore seldom successful instruments of change under these circumstances.

At the same time, regular teachers are very often provided super workshops in the latest techniques and teaching materials, only to return to their accustomed ways of doing things once the consultants have disappeared round the bend, or once the teachers have returned to their respective school campuses. These are rather serious problems with which teacher educators are faced.

The "Portal School" concept is an attempt to overcome such problems as I have outlined and is a very important facet of the Teacher Corps model. When a teacher corps programme is being conceptualized by a participant university, it must be done in co-operation and in consultation with the administration and staff of a local school selected to serve as a portal school. And, following the short pre-service programme on the college campus, the new teacher interns are assigned to that school, or to a cluster of primary schools in an area, as the case may be.

The portal school is where practice and demonstration of competencies with students takes place. It is, as the term suggests, a port of entry to the educational system of the country - that is, for new teachers, for new ideas, teaching materials, and strategies - a prototype for the introduction of something new to the establishment, one might say. A portal school setting is also where pupil learning can be assessed if it is to be the criterion for establishing competence of teachers. If demonstrated pupil learning is not the criterion for establishing competence, then the teacher is responsible for exhibiting those teaching behaviours assumed to be effective in teaching reading comprehension to pupils.

Governance of the portal school programme is the concern of a team made up of representatives of the co-ordinators, instructors, school administrators, classroom teachers and the interns themselves. The college staff responsible for in-service courses from the university includes instructors from such diverse fields as educational psychology, guidance and counseling, social sciences, natural sciences, mathematics, reading, language, health and physical education. The "field staff" includes the school principal, supervisors or inspectors and classroom teachers, all of whom receive training for their roles before the arrival of interns.

Thus, the portal school experience must include in-service training for administrators, in-service training for regular teachers and for the interns themselves. Indeed, it calls for in-service training for the Ministry. In-service is therefore carried on simultaneously in the same setting. Because

of the involvement of university staff, teacher education becomes the joint concern of the university and the public school system.

With each subsequent funding through Teacher Corps, new clusters of schools in various areas of the nation would be selected as portal schools, and during the in-service year additional resources are poured into each school until the entire administrative and teaching staff have been upgraded.

In summary, the significance of the NTC concept for Kenya and other interested nations is multiple:

- It utilizes the untapped resources of the vast numbers of school leavers currently unemployed, for primary programmes throughout the nation.
- It immediately places committed teachers in these schools, who by many standards are equally or better trained than regular staff.
- It provides in-service preparation for existing administrative and teaching staff in the primary schools, upgrading their teaching skills and professional development.
- It fosters community development and education through literacy projects and other educational projects supported by Teacher Corps interns.
- It increases the capabilities of teacher training institutions for flexibility, creativity and innovation in preparing educators to meet the needs of national development.
- It expands and qualifies the role of the national government in teacher education and in public education in general.
- It facilitates national unity through preparation and placement of all ethnic groups in the teaching profession; it fosters co-operation among diverse cultures, and supports the development of literacy in both English and the national language.

THE SIERRA LEONE PRE-SERVICE ENVIRONMENTAL SCIENCE PROJECT : By Dr. Magnus J. Cole

As is already presented in the Country Report for Sierra Leone, the Science Curriculum Development Centre with the support of SEPA and the Institute of Education, University of Sierra Leone embarked on a pre-service environmental science project in 1972.

This project is rationalised on the basis that the African Primary Science Programme (APSP)/SEPA materials had been introduced into the primary schools of Sierra Leone through intensive in-service programmes for primary teachers since 1970 or earlier. It was therefore time for this programme to be introduced at the pre-service level for prospective teachers at the Teachers Training Colleges in Sierra Leone. Such a move, we predicted, would produce a core of new teachers who would enter the primary teaching profession fully conversant with the philosophy, methodology and practicality of the environment-based science teaching programme embodied in the APSP/SEPA materials.

These new teachers, it is hoped, would enrich the pool of competent primary school teachers and assist those of their colleagues who may or may not have benefitted from the already established in-service courses spearheaded by the Science Curriculum Development Centre at Njala University College and the Inspectorate of the Ministry of Education in Sierra Leone.

The Environmental Science Project has been delineated into three stages, viz.:

I. Exploring the environment.
II. Exploring areas of knowledge pertinent to the primary school child.
III. Treatment of matter and energy.

These areas are adequately presented in the Project Report -"Our Environment" - a science handbook for teacher training colleges.

In 1972 these stages were outlined and since then the Science Curriculum Development Centre staff and the science lecturers of the teacher training colleges have been developing the various stages.

With respect to Stage I - Exploring the Environment, a lecturer in science of Bo Teachers College worked with his students - exploring the environment. The report of his efforts is in the handbook entitled "General Science for T.C. Students".

This report shows, for example, that the market was visited. Important aspects of such an environment included:-

- The position of the market in the town: this position is seen as related to the area of greatest population density and easy access to it.
- The size of the market.
- Structure and arrangement of market:
  open markets were found to be opened at certain periods, whereas closed markets undertake daily business.

- Types of people found in the market - buyers, sellers, observers or 'window-shoppers'. Languages are varied. Dresses vary.
- Number of people in the market. By counting number of people in one area, one may be able to estimate total market population.

Other categories of elements of the market include:
Types of food
Buying and selling mechanism
Rules of the market.

Types of food classified according to: -Energy producing;
-Body building; and
-Protective foods.

Other uses of food include:
- preservation of other foods by palmoil, salt;
- preparation of soap;
- distillation of alcohol.

Another environment investigated was the hospital. Clinics, wards, sterilization processes, common cases of illness, hospital routine and operations were investigated.

The school, the local blacksmith's forge, the carpenter's workshop were among other environments visited.

Instruments and tools were to be developed in order that proper investigations could be made, as well as to replicate natural environments for study. These aspects lend themselves to development of skills, attitudes and insights for the investigator who may be the pupil or the teacher. This process of investigating the natural environment as well as developing tools for investigating the natural or stimulated environment is seen in the available photographs of participants at the current workshop on environmental science for teacher training at Njala.

Further development of background materials pertaining to the school child is seen in the brainstorming expressed in the short paper by Prof. J.A. Easley on "A Naturalistic Study of Termites - Primary Report - July 14, 1974".

In this paper Prof. Easley presents a series of questions on a commonly occuring aspect of the environment which previously had been overlooked. By raising such questions, a better insight into termites would be derived than would otherwise have been acquired from books dealing with the same element, termites, but far removed from the local environment. Other aspects of the local environment being investigated at the workshop included solar energy through construction of a solar furnace; electricity and electromagnetism; leaves, rocks in the environment and so on.

Aspects of the environment dealing with conserving and pollution of the environment have so far been left untouched, notwithstanding the fact that there are polluted areas of our environment as well as need for restoring certain aspects of our environment.

MID-WESTERN NIGERIA PRIMARY SCIENCE PROJECT

G.N. Sharma - UNESCO Science Adviser

An effort has been made in Mid-Western State, Nigeria, to orientate the science education programmes in primary schools and teacher training colleges towards environmental science education. The Primary School Science Curriculum has been designed around the following nine themes:

- Animal life
- Plant life
- Our health
- Safety measures
- Our universe
- Air, water and weather
- Rock, soild, and minerals
- Measurement, force, work and energy, and
- Materials around us.

All the nine themes are continued from primary one to six. The child goes deeper and deeper into their investigations, as he passes from lower classes to higher ones, and as the curriculum spirals from the simple to the more complex. In the introduction of the Teacher's Guide for primary classes I to III, "Science is Discovering", it is emphasized that the primary science course is intended:-

- to enrich the child's environment in order to heighten the enjoyment of his explorations and investigations; and
- to accelerate the development of desirable scientific attitudes, interests and certain basic concepts.

No pupils' texts have been developed for the first three years of primary school science programme, but the teacher's guide gives a lot of background information for the teachers, and suggests numerous environmental problems to encourage the child to observe his environment with keen interest and to investigate it to discover the solutions of the problems, with which he is faced. Using this "problem-approach", for example, under the topic "Animal Life", some of the problems posed before the children in successive classes from primary I are as given below:

- What are the common animals?
- In what ways animals differ?
- What are the characteristics of living things like animals and plants?
- What are the different kinds of animals which are seen on land and in water?
- What are their body features? And why?
- What do animals require for their growth?
- How do animals serve mankind?
- In what different ways animals eat?
- In what different ways animals breathe? and
- How animals reproduce their kind? And so on.

Similarly under the unit "Measurement, Force, Work and Energy", the following problems are handled by the children:

- What do we do when we need to measure distance between two points, the interval between two events and the mass of a body?
- What effect does a push or pull produce on a body?
- How to make plans of a table, a classroom, school compound, etc. on the paper?
- What is the result of work done on a body?
- How can push or pull be transferred by mechanical devices?
- Why do we say that energy is stored in food?
- What are other devices of storing energy?

In short, the efforts have been made under this project to help the child to know his environment more closely in a meaningful way. His interest is developed to appreciate the problems of environment.

Since the Government of Mid-Western State decided to introduce this course in all of the primary schools, the shortage of trained and competent science teachers has been a major constraint in developing the teaching materials which include a teacher's guides, pupil's texts and science kits. A large number of teachers have been trained in three -month in-service training courses at the Permanent In-service Training Centre, Abraka, and science has been introduced as a compulsory subject in all pre-service training programmes of teacher training colleges. But it is not possible to train all the teachers who are teaching at present in all the primary schools within a limited period of time. Hence some of the activities included in the course are not intentionally kept open-ended. In some places in the pupil's text the solution of the problems has been given after a problem has been posed, so that the child who is not fortunate to have the guidance of very competent teachers and overall facilities to work may not be discouraged from going ahead and may continue to sustain his interest in the course.

It is hoped that as conditions in the schools improve, and more and more trained science teachers become available, the course will be continually revised and modified by those at the Science Curriculum Development Centre, Abraka, to lay increasingly more stress on open-ended investigations by the primary school children.

Conclusion: The demand of the day is to help the teachers under training to understand and appreciate the problems of environmental science education. It is possible by developing a regional environmental science education project, so that teaching materials may be developed, tested and produced for use in pre-service training programmes of teacher training colleges. This will enable the teachers trained under this programme to use their experiences in teaching environmental science to children in primary and junior secondary schools effectively.

THE EXPERIMENTAL INTEGRATED PROJECT ON EDUCATION FOR RURAL DEVELOPMENT "NAMUTAMBA PILOT PROJECT" : By D.S. Kiyimba, Director

Introduction

Many of you in this conference may have known about the Project, but for the benefit of those who may not have known its history before, I shall go over it very briefly and refer you to the pamphlet I have prepared to illustrate in pictorial form the different aspects of the Project.

The resolution which established the Namutamba Pilot Project was promulgated in 1967 during the 14th Conference of UNESCO. The resolution required the establishment of a Pilot Project in Africa to investigate the adaptation of primary education for development of life in rural areas. During this conference, Uganda offered to provide the experimental site for the Project. After a thorough survey of possible sites in Uganda, Namutamba TTC with the 15 associated Primary Schools in its vicinity was selected.

Most people refer to the project as one which aims at benefiting all primary school children regardless of whether, after leaving primary school, they will proceed to secondary schools or remain on the land in rural areas. This will become evident through its systematic environmental practical approach. Let us now have a visual analysis of some aspects of the Project, aspects which relate to environmental science. (Slides accompanied the following notes).

The Environmental Outdoor Approach:-

- An over view of the college compound - fashioned;
- A study of effect of weather on different wood from Namutamba environment;
- The college pond for the study of fresh water biology - a variety of water plants and animals;
- Weather station - studying Namutamba rainfall : NTTC Weather station;
- Namutamba Dem School watch small shed where records are kept;
- Desert plants brought into the environment - ecological study;
- Study of rocks of Uganda - iron slag : NTTC;
- Study of rocks of Uganda - limestone : NTTC;
- A collection of rocks from Namutamba environment : NTTC
- Weather recording : NTTC;
- Pulleys - demonstrating the principle of pulleys : NTTC;
- Carton nest auto from environment : NTTC;

Using the Environment:-

- Students in a marrum pit;
- Investigating properties of magnetism - magnetic and non-magnetic substances;
- Children explaining electrical equipment they have made from local materials found in their environment - investigation of properties of electricity : Dem School;
- Overcoming superstitions and fear - handling python : NTTC;
- Using the ground for acquiring writing skills - Kawoko Primary School;
- Beehive made by children for study of behaviour of bees.

Construction of Teaching Aids:-

- Teacher and pupils constructing a ground map of Uganda physical features : Dem School;
- Collection of bones from the environment for study of skeleton : Dem Sch.;
- Skeleton of a fox (killed by car) prepared and mounted by teacher and his pupils - study of skeletons (note the display table made from reeds by the pupils;
- Improvised incubator : NTTC;
- Study of steam turbine using tin : Kiwawu P.S.
- Children constructing a house for their ducks : Kalangaalo P.S.

Restoring the Environment:-

- Eucalyptus forest - planted at schools : N. Dem School;
- Cuttings ready for planting : NTTC;
- Arboretum - hard and soft wood forest : NTTC.

Field Approach Relating to Environmental Science and Production Opportunity of Agriculture and Self-employment:-

- Children and teacher examine a sick broiler : Kiwawu P.S.;
- Children feeding their broilers : Kiwawu P.S.;
- Learning about mammals from a living rabbit, not diagram or charts : Kiwawu;
- Treating a piglet : NTTC;
- Collecting eggs .. happy moment : NTTC;
- Children making brooder for chicks : Mityana P.S.;
- Poultry - goat houses and rabbit cage - Kiwawu P.S.;
- Piggery at Naama Primary School - animal husbandry;
- Primary school leaver with his hybrid of zebu and resian cow;
- Keeping a goat at school - Kiwawu P.S.;
- Mulching their banana garden : Buyambi P.S.;
- Nursery shed - Naama P.S.;
- Children in pineapple garden - Naama P.S.;
- Experimenting with upland rice : NTTC;
- Growing belta maize : Buyambi P.S.;
- Studying nodules on groundnuts plant : NTTC;
- Digging in the soyabean garden - source of protein : Kalangaalo P.S.

Marketable Skills:-

- Art and Craft - brooms from guinea grass - carpets from papyrus - baskets from rafia and mats from palm leaves : Naama P.S.;
- Treaty layers - animal husbandry : NTTC;
- Building a pig shed: NTTC;
- Brick laying and making : NTTC;
- Building a poultry house : Buyambi P.S.;
- Art and craft from local materials : NTTC;
- Carpentry - construction of Teaching Aids, tables, chairs, stools, etc.

Community Involvement (Integrating School and Community):-

- Mothers at school learning mat making : Kitemu P.S.;
- Adult literacy class at school : Kitemu P.S.;
- Parents and children and teachers use cinvaram machine for making red soil blocks.

Synthesis:

After taking you through the visual analysis we should find a synthesis for Namutamba Pilot Project. The project intends to innovate the primary teacher training curriculum and that of primary education to relating it to the environment, making it beneficial to the land and the society, and making it reflect the realities of rural society development.

It is hoped that fully implemented, it will transform the whole structure of Uganda's primary education system to an environmental scientific approach; scientific because it will be the result of an analytical study of what the realities of life of the primary pupils, teachers and community in Uganda are.

This environmental scientific approach will be how to practically solve some of the identified problems in our education and our environment, problems such as how can any part of the community achieve developmental transformation with the optimum use of human and other available resources in their environment, in other words, how can our people apply themselves in utilising their environment to develop themselves, create jobs, eliminate hunger, eat a nutritive diet rather than just food and - how do we best conserve our natural resources from plunder, plunder by natural elements such as pests, diseases, soil erosion and so on, and plunder by man himself such as pollution, deforestation, over-grazing and mechanisation.

This is what Namutamba project believes can be done through a widely based scientific, environmental practical approach to education, accessible to the biggest majority of our population at an early age, that is a scientific environmental oriented primary education.

Integration:

In this project, the concept of integration is strongly realised. There is an integration of subjects and subject groups. There is an integration of inter-ministerial services in pooling of resources and sharing of facilities to obtain maximum benefit from them for rural development. There is an integration of the community.

Both young and old can come together and use the school as one of the sources through which new knowledge and ideas enter the community, both intellectual and cultural knowledge. In the past primary education has tended to isolate the child from his environment or community thus making him regard the school as a different entity in itself. This has made transfer of knowledge from school to home and home to school difficult.

There are, however, several questions to be answered, for example, the question of a National Selective Primary Leaving Examination. What should be the system and format of the examination suitable for this environmental practical approach? There are several other questions on environmental education and the environment itself, like its utilisation, transformation and conservation.

Many other means to the goals and objectives cited in this paper have been advocated, but it is my strong belief and conviction that the most effective means will be through education, education of relevance, of practicability, creativity of environment, self-motivation and employment; that is, education in the practical sense of the word.

V SUMMARY OF WORKSHOP TASKS - as reflected by initial presentations - by Prof. E.A. YOLOYE

1. Defining Environmental Science: 3 components seem to have been identified, viz:

   i) Gaining Scientific Knowledge about the environment. (Teaching about the environment)
   ii) Using the Environment to develop certain intellectual scientific skills as well as practical skills, and other benefits. (Teaching from the environment)
   iii) Identifying and Solving of problems of values, practicality and safety in man's interaction with the environment. (Teaching for the environment).

   Questions: a) Do these components cover all that is meant by environmental science?
   b) Is it possible to isolate 'environmental science' from 'environmental studies'?

2. Projected Output from Workshop:

   i) Identifying a target population at which environmental science education is aimed (a. primary school children and b. adult and dropouts from primary school seem to be suggested).
   ii) Prepare guidelines on a curriculum in environmental science for this population.
   iii) Prepare guidelines for a teacher education programme for teachers to implement the curriculum as prepared. (Pre-service teacher education has been suggested).
   iv) Make proposal for translating guidelines into action on a Pan-African basis.

   Questions: a) Is there agreement on suggested target population as top priority?
   b) Should we focus on teachers as the sole manpower source for implementing environmental science programmes, or should we right from the beginning involve manpower from other sectors?
   c) With respect to teachers, should efforts be limited to pre-service training?
   d) Does the list of outputs above adequately represent what is intended?

3. Modus Operandi:

It is proposed that the workshop accomplish its task through a combination of plenary sessions (discussions involving every participant) and group work. Task (i) requires plenary session. Tasks (ii), (iii) and (iv) require group work followed by plenary session.

Criteria for Groups: A feasible procedure for breaking into groups seems to be:

(a) form 3 groups each to tackle one of the three aspects of environmental science identified in 1.
(b) Each group should carry out tasks (ii) and (iii) with respect to the chosen aspect.
(c) A fourth group,which should be formed after the three groups have worked for a day and given preliminary reports, should tackle task (iv).

Final reports for all four groups should be considered during the last sets of plenary sessions.

Questions: What are alternative feasible ways of breaking into groups to accomplish projected tasks?

4. Guidelines for Group Work:

General:
(i) Africa should define her own environmental problems.
(ii) Emphasis should be on developing local, indigenous expertise in identifying and solving environmental problems.
(iii) There is a continent-wide concern about what happens to children after primary school with respect to employment, further education, earning a living and generally being a good, useful citizen.
(iv) Different countries may have different socio/economic/political philosophies.
(v) The language of instruction may be a very critical factor in the educational programme.

Specific: Examine existing materials and approaches and make recommendations on adoption, adaptation, supplementation or substitution.

VI-1 WORKING GROUP REPORTS

GROUP 1 REPORT

A Curriculum Guideline in Environmental Science for Teacher Educators in Africa:

Introduction

The group was concerned with identifying areas of scientific knowledge about the environment. The group was of the view that guidelines on a curriculum for environmental science sh-uld be directed primarily to the curriculum development. Six major aspects were considered:

1. Some Major Themes:
   (1) Plants and light
   (2) Weather and living things
   (3) The living soil
   (4) Water in the life of plants and animals
   (5) Animal movement
   (6) Plant cultivation (see example on Page)
   (7) Improvement of living things (breeding)
   (8) The beginnings of life (Pollination, Fertilization, Animal Reproduction, etc.)
   (9) Social life (insects, wildgame, birds, etc.)
   (10) Life in fresh water and/or in the ocean
   (11) Food processing
   (12) Management of waste material.

Plant Cultivation: presented as an illustration of some of the skills and experiences that would be involved in the study of one of these themes in the child's environment. The list is by no means exhaustive and the study would naturally consider the age and ability of the children concerned.

Basic Skills :

Mathematics
- Working out cost of seeds, fertilisers, labour, etc.
- Yield and profit margins;
- Estimation and measuring of areas of deforestation, bush clearing and where various crops are grown;
- Scale in modelling exercises.

Language & Communication
- Descriptions of "on-site" visits,
- Descriptions of animals and plants observed,
- Documentation of stories associated with indigenous folklore.

Creative Activities
- Modelling of farm houses, homes,
- Making of puppets in local dress,;
- Ideal farm model.

Study Skills

Mapping - Construction of map of the area farmed; relationship to school site,
- Areas to which food is distributed, distances travelled and direction.

Observing, Collecting & Classifying - Different building materials in the village and farm,
- Plants and animals in the area,
- Classification of crops grown.

Experimentation - Use of experimental plots, e.g. use of fertilisers, weeding/not weeding, etc.
- Germination experiments,
- Soil investigations,
- Efficiency of tools being used - good design, bad design and why,
- Scientific examination of folklore and cultural practices.

Comparison of Past/Present (Change) - Changes in the village and farm in the last 50/100 years,
- Changes in machinery used, e.g. last 20 years, mechanisation,
- Old maps (if any) of the area, comparison with present day.

Construction & Use of Questionnaires - Interviewing of farmers, old inhabitants, to ascertain changes in techniques or custom - if any.

Interpreting Data - Figures of crop yield and advantages and disadvantages associated with e.g. use/overuse of fertilisers, biocides.

Social Skills

Respect for the Environment - Energy relationships in the environment photosynthesis,
- Food chains and the dangers and problems of food chain disturbance,
- The idea of interdependence and the importance of man,
- Aesthetic awareness of the environment.

Respect for People Living in the Environment - Cultural traditions associated with:
a) farming, i.e. crops grown, shifting cultivation,

b) stories, folklore concerning plants and animals;
c) harvesting or any seasonal activity.

Applied Operation Skills:

Agricultural/Technical Skills -
- Design and construction of metal/wooden tools;
- Making of simple wind and water mills;
- Techniques associated with use of various tools.

Art/Craft Skills - cultural craft techniques, old and new practices.

2. Conceptual Schemes (with Emphasis of MAN)

Adaptation of plants and animals to the environment:-
- to the major habitats (land, water, air)
- tolerances, e.g. adaptations to physiological factors.

The Balance of Nature:-
- Plants as primary producers;
- Interdependence of living things;
- Consequences of disturbing nature;
- Rational uses of the resources of nature.

Changes in the life of plants and animals:-
- change in numbers,
- change in form,
- seasonal change,
- life cycles.

Interaction between nature and technology.

3. Methodological Approaches:

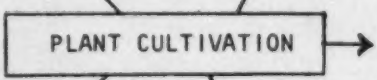
- "Inquiry and problem solving" method.
- Use of local environment both as laboratory and subject for investigation.
- Child-centered approach with the child as the active investigator and teacher as a motivator.
- Scientific investigation, observation, recording and interpretation by the children.
- Use of a variety of ways of solving problems.
- Work individually and in groups.

4. Relationship of the Environment to the Child in Africa:

- Building on indigenous beliefs, culture and folklore which have scientific basis.
- Attempting to resolve conflice between science and superstition.
- Adapting and using locally available inexpensive material.
- As much as possible using indigenous material rather than foreign ones.

. Evaluation:

- Continuous assessment; using suitable methods, e.g. anecdotal records.
- Testing mastery of skills.
- Observing changes of attitudes to the environment.
- Evaluation of curriculum through feedback.
- Testing of understanding basic facts and concepts.
- Testing of aptitudes.



Social Studies

Mapping out the area farmed
- relationship to the school site.
Areas to which food is distributed.
Cultural traditions associated with:
- farming, i.e. crops grown, shifting cultivation;
- stories, folklore concerning animals and plants;
- harvesting or any seasonal activity.
Interviewing of farmers, old inhabitants to ascertain changes in technique or customs - if any.

Mathematics

Working out costs of seeds, fertilisers, labour, etc.
Yield and profit margins
Estimation & measuring of areas of deforestation, bush clearing, etc.
The idea of scale for modelling.

Craft

Design & construction of metal/wooden tools.
Making of simple wind & water mills.
Cultural craft techniques - old & new practices.
Models of various farm buildings.
Pictorial representations of various land areas.

Science

Classification & study of trees in the area - their use and misuse.
Classification of crops grown.
Use of experimental plots, e.g. use of fertilisers, weeding, etc.
Germination experiments.
Soil investigation.
Mechanical efficiency of tools being used - good & bad design.
Energy relationships in the environment; photosynthesis; food chains & the idea of interdependence; problems of food chain distrubances.
Scientific examination of folklore and cultural practices.

Language

Descriptions of "on-site" visits.
Descriptions of animals and plants.
Documentations of stories associated with indigenous folklore.
Preparation of questionnaires for interviewing farmers, old inhabitants.

USING THE ENVIRONMENT TO DEVELOP CERTAIN SKILLS IN CHILDREN — GROUP 2 REPORT

Introduction

The two major tasks of the group were to prepare curriculum guidelines on using the environment in developing certain skills in primary school children, and to prepare guidelines for a teacher education programme for such an approach. Existing materials were examined as a basis for discussion and an environmental studies approach was outlined. It was agreed that the Environmental Science scheme should be child-centered and to this effect, the skills to be developed were classified into four groups:

1) Basic Skills: Mathematics
Language and Communication including - factual writing
- imaginative expression.
Creative Activities
Use of Source Materials - books, pamphlets, maps, photographs, etc.

It was felt that it was not possible to teach all aspects of these skills environmentally but using the environment would automatically utilise and develop them.

2) Study Skills: Observing: mapping, collecting and classifying
Experimentation e.g. prediction, inference, formulating hypothesis, controlling or manipulating variables, formulating models
Comparison of past/present - concept of change
Construction and use of questionnaires
Interpreting data.

These skills are those needed by the children to investigate their environment.

3) Social Skills: Respect for the environment;
Respect for people living in the environment.

The development of these skills and the intimate association of the child with its environment and culture is of prime importance in the African situation.

4) Applied Operational Skills: Agricultural skills
Art/Craft skills
Technical skills
Those skills associated with homecraft/management/economics/technology.

The applied operational skills were seen by many people to be a culmination of many other skills to produce a training for life. A great deal of discussion centered around the last group of skills and it was agreed that, although all countries might not accept the skill classification in this form they, nevertheless, were of great importance to those countries where primary education was terminal for a large majority of the people.

The apparent overlaps of certain areas with social studies was discussed. Some delegates wanted a clear demarcation between environmental studies and environmental science but most agreed that integration was inevitable.

Use of the Environment in Developing Skills

The discussion indicated that two approaches were currently being used:

- With skill development in mind, an aspect of the environment is chosen and the child learns as much as possible from it. (Open-Ended Approach).
- A decision on what to learn is made, then the child is taken into the environment to learn about it - (Limited Objectives).

Some members of the group considered that the latter approach would have more appeal to the inexperienced teacher; others thought that the differences were of degree and the teacher may progress gradually from the first approach. The approaches are not mutually exclusive as illustrated by SEPA materials. The group considered that the SEPA materials, especially the report of the Workshop 1971 and the Sierra Leone Project, clearly indicated the ways that the environment might be utilised.

Two other points emerged from the discussion:

- There was a need to incorporate environmental science studies, including conservation, into primary examinations in order to make their teaching more mandatory.
- A concentric approach in environmental science is important; the child must not concern himself solely with study of his immediate environment but should progress to a consideration of other environments.

Teacher Education Programme for Using the Environment

A review of the teacher training programme in the participating countries was attempted from the limited information available. Two patterns of recruitment and training emerged:-

- Admission after 'O' Level equivalent plus 2 or 3 years training.
- Admission at the end of primary school plus 3 to 5 years training.

An analysis of the training programme was attempted under the following components:-

Content; Foundations of education; Methodology specific to the various subjects; Teaching practice.

Further contact with children, besides teaching practice, was a feature of the programme of certain countries - especially through their demonstration schools.

The differences in recruitment and the training patterns were reflected in

the emphasis the countries gave to the content in the teacher education curriculum. The time devoted to content ranged from approximately 35% to 85% with the majority of countries spending 50% or more of their time in this area. Most delegates considered that the time devoted to methodology was inadequate, especially if an environmental approach is to be adopted. Two alternative suggestions were made for the provision of more time to train teachers in the environmental approach:-

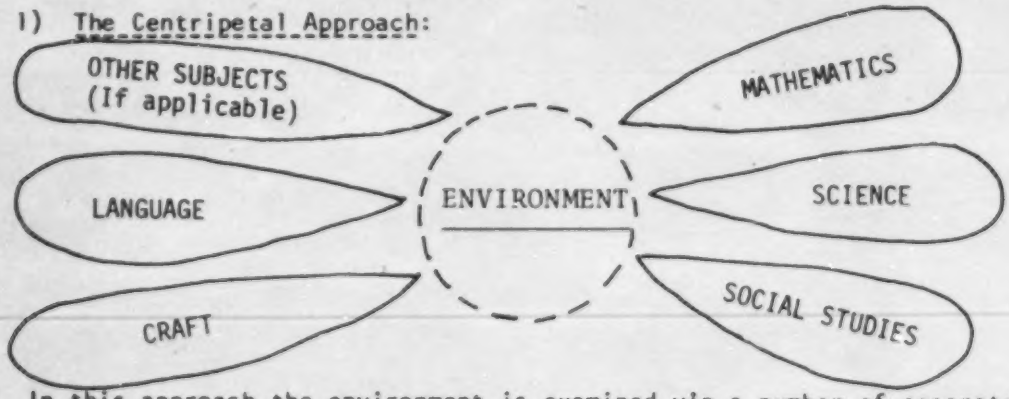
- Increase in the length of training;
- Restructure the time within the existing arrangements, e.g. a unit of instruction designated "Environmental Studies" incorporating the development of skills relevant to the various subject areas could be introduced. These skills have already been designated earlier.

The introduction of such an approach calls for the retraining of teachers, teacher educators, inspectors and educational administrators; and there is an obvious need for extensive and intensive in-service courses.

It was felt that an effective mechanism be devised to distribute materials relevant to the environmental approach, e.g. SEPA publications, direct to teacher training establishments. Furthermore, there should be an exchange of ideas and personnel at this institutional level.

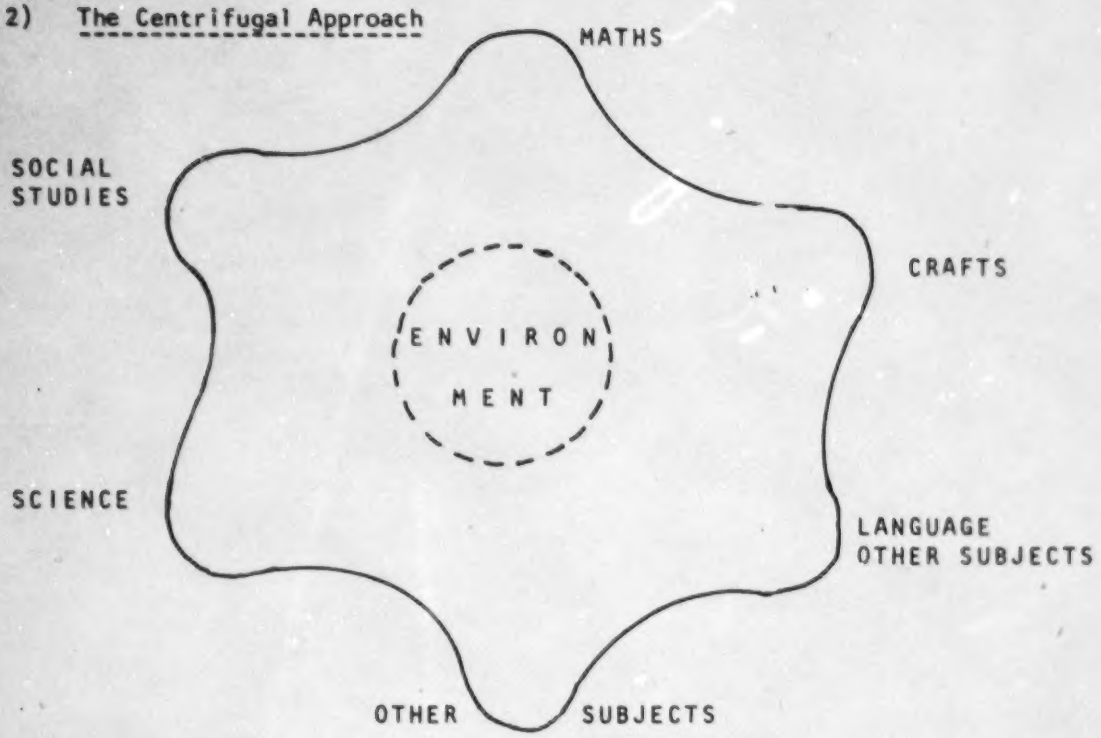
A major problem emerging in the training of teachers to any novel approach is the psychological one of the teacher feeling inadequate in the situation where he does not know all the answers. A variety of approaches need to be considered in order to overcome this formidable problem. It was agreed that teachers should not consider themselves to be the "fountain of all knowledge" but must accept the fact that on many occasions they must be honest and admit their ignorance. The important thing, however, is that teachers should know how to find out the answers. Such activities, involving teacher and pupil working together, often give the opportunity for genuine scientific investigation. Furthermore, teachers should always be ready to accept new ideas and also critically evaluate accepted practices. The group strongly recommended that trainee teachers and teacher educators should go through the same processes and have similar experiences to those that have been recommended for children. It was recognised that this would involve a new approach at teacher training. In order to guide implementation, two models were considered:-

1) The Centripetal Approach:



In this approach the environment is examined via a number of separate subject areas.

2) The Centrifugal Approach



In this approach the environment becomes a core of study with the separate subjects contributing to the core and extending outwards from it.

The group considered that the latter scheme involving a multidisciplinary approach and the consequent integration of subject tutors had the following advantages:-

- It is based on the child's experiences and not adult divisions of knowledge;
- it makes more time available for "on-site" working in the environment;
- the interrelationships and interdependencies present in the environment are made more meaningful to the pupils.

One particular problem emerged from discussion and that was the abhorrence felt by certain teachers to certain features in the environment, e.g. spiders, snakes, etc. The group accepted that this was a difficult problem but in many cases the fear arose because of ignorance. This led the group to the general proposition that teachers should be aware of all the sources of information available to them e.g. publications from UNEP, UNESCO, UNICEF, museums, National Parks, local industries, the Ethiopian publication "Discovering the Environment", and the Tanzania film "Let's Find Out", the publications from SEPA and Sierra Leone mentioned previously being particularly relevant.

IDENTIFYING AND SOLVING PROBLEMS OF VALUE GROUP 3 REPORT

Introduction: The main concerns of the group were that the general public was unaware of certain problems in the environment. These problems relate to the damage done to forests, wildlife, pastures, soil, domestic animals, water and air. There is, therefore, an urgent need for the sensitising of children, their parents and teachers to wiser management of the environment.

Objectives for a Teacher Education Curriculum

A. Conservation of the Environment:-

- To enable the child to be aware of the importance of conserving the environment around him.
- To enable the child to acquire knowledge and understanding the destructive processes and their effects by man's interaction with the environment.

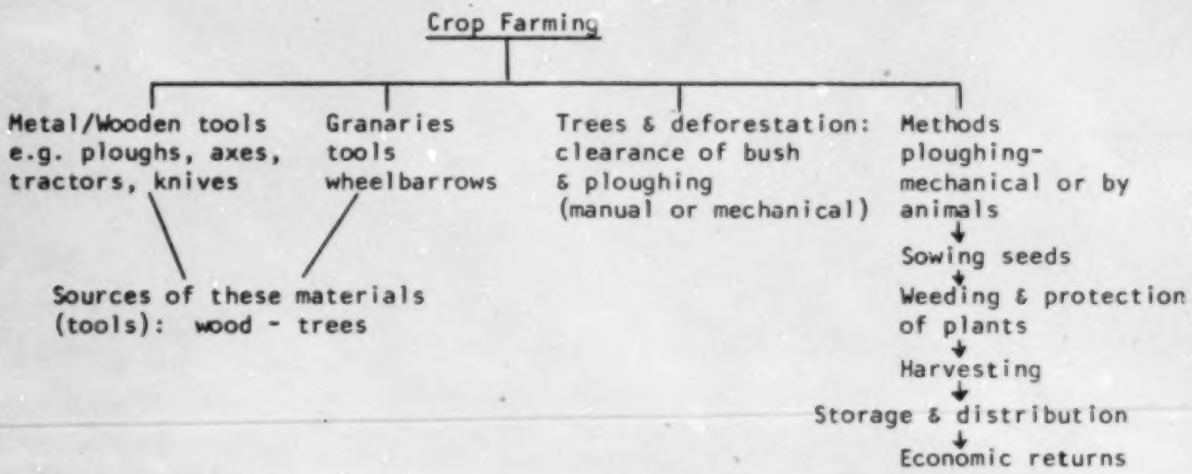
B. Utilization of Environment:-

- Enabling the child to acquire skills for utilizing the environment without disturbing the balance of nature (ecosystem).
- To enable the child to develop conceptual and analytical abilities for problem-solving for environment protection.
- To enable the child to communicate effectively to his community his concepts on the problems of the environment and be an instrument within his community for preserving the environment.

C. Attitudes toward Proper Use of the Environment:-

- Enable the child to investigate into traditional attitudes and beliefs toward the environment and its uses.
- To enable the child to develop attitudes toward developing environment for communal benefit.
- To let the child be aware that not only industries and mechanised processes harm the environment but man himself as an individual can harm the environment.

Illustration of a Possible Approach to a Study of the Environment:-


Crop Farming
Metal/Wooden tools e.g. ploughs, axes, tractors, knives
Granaries tools wheelbarrows
Trees & deforestation: clearance of bush & ploughing (manual or mechanical)
Methods ploughing- mechanical or by animals
Sowing seeds
Weeding & protection of plants
Harvesting
Storage & distribution
Economic returns
Sources of these materials (tools): wood - trees

Effects of this on the Environment:-

Bush clearing:

- Burning causes air pollution;
- deforestation/depasturalization by bush clearing : wild animals are diminished, lack of water, wind erosion, silting of rivers;
- chemical fertilizers, biocides.

Possible Questions & Solutions to Environmental Problems arising from farming:-

Bush clearing:

- Is it necessary to do large scale clearing of bush and why?
- What effects arise from this large or small scale clearing?
- What are the effects on the animals living there, air, soil, rainfall, atmospheric temperature changes, wind and water erosion - to man himself, and why?
- What are the activities in the farm which cause soil erosion, and how can this be avoided?
- Should farming on slopes be discouraged?

Energy Relationships and Requirement within the Environment relating to farming:-

Heat energy:

- Energy requirement on the farm;
- man and machine;
- plants;
- sources of energy (1^{o} sun : 2^{o} oils; electric, water, wind).

Wastage of energy:

- Defective equipment;
- inefficient equipment.

Alternative or other agricultural equipment (tools):

- wind mills;
- water mills.

Guidelines for Teacher Education Curriculum:

Content (Forestry as an example)

Advantages of forests -

- sheltering wild animals;
- help in obtaining rain;
- provide timber, furniture and construction materials, etc;
- provide food.

Damages done to forests -

- constant felling of trees for fuels;
- deforestation for large scale farming;
- deforestation for timber industry, wood carvings, furniture, building materials, etc;
- deforestation for road construction, etc;
- deforestation for residential areas;
- deforestation by bushfires.

Solutions to Deforestation:

- trees have to be planted for every one cut down (aforestation);
- prevention of indiscriminate use of wood materials and exploring alternative sources of energy;
- protection of rare species and indigenous plants;
- elimination of bushfires;
- controlled use of biocides.

Professional - Methodology : Teacher must be trained in:-

Use of discovery approach at pre-service level:
- collect materials (teaching);
- construct apparatus;
- simulate nature as far as necessary.

Foundations:
- should understand or be familiar with the physical (psychological and intellectual) development of the primary school child;
- should be familiar with the psychological and philosophical bases of discovery learning;
- should be familiar with the cultural traditions and aspirations of the community whose children he will teach.

Nature of Training:
- Model schools should be available for the implementation of this pre-service programme.
- Workshops facilities at the teacher training colleges should be available for the students making apparatus for the programme.
- Each primary school should have facilities where children can make their apparatus.
- Apparatus should be made from local materials as far as possible.
- Teacher educators should get seminars and refresher courses to bring them up to date in new methods of teaching.
- Teacher educators should be specially prepared through a programme which prepares them for teaching teachers.
- Wherever possible, teacher training should be in the official language of instruction.
- Teacher educators for primary teacher training should be indigenous people.

VI-2 WORKSHOP RECOMMENDATIONS

GROUP 4 REPORT

Introduction:

Expressing the need for action in environmental science education at a Pan-African level, one of the consultants said any African country deciding to go it alone would be like a single gazelle in the midst of Serengeti National Park - in a wild and thick bush with lions, hyenas, wild dogs, etc. converging towards it.. It will only be a matter of time before it perishes.

Guidelines of Other Groups:

Groups 1, 2 and 3 have provided guidelines which imply a preventive approach to the preservation and improvement of a good quality environment. Among the essential ingredients for constructive awareness and action in respect of the improvement of the human environment are:-

- an informed citizenry about wise management and use of the environment;
- a sufficient pool of suitably trained manpower in the teacher training colleges;
- a wider and increased availability of resource materials for teacher training colleges, tutors, teachers and young children.

Recommendations:

On the basis of the guidelines of the other groups, it appears that international activities should incorporate the following:-

1) Since local initiative is of critical importance in environmental science education, each country should define its needs for SEPA to respond and support.

2) Follow-up workshops for teacher trainers on regional basis. These workshops should be aimed at developing the teacher trainer himself and at producing support material.

3) Development of materials for schools and teacher training colleges should take place on a co-operative basis at production workshops and at subsequent writing workshops.

4) Training courses for teacher educators and other leadership personnel should be embarked upon in order to increase the pool of suitable human resources.

5) Individual countries should send information on their activities to the SEPA Secretariat which will in turn circulate it through a newsletter and public information media.

6) The SEPA Secretariat should devise a means of collecting and assessing basic information on African communities and how it can be incorporated into environmental science education activities and learning materials.

7) SEPA should communicate the products of this Workshop to other international funding agencies such as UNICEF, UNESCO, UNEP and IUCN (International Union for Conservation of Nature and Natural Resources) and should develop appropriate future activities in this field with the co-operation of these agencies in the manner UNICEF and UNESCO have done already. Among the future activities should be programmes for developing awareness and understanding of environmental conservation activities by the general public.

8) Identification and encouragement of sources normally regarded as most directly involved with education to recognise their role as more direct in teacher education than ever before, e.g.

National Parks,
Museums,
Industry.

9) Individual countries, SEPA and other organisations should circulate materials and inform member countries of what is happening elsewhere, e.g. available films and other materials.

VII ANNEXES

ORDER OF ACTIVITIES

Monday, 22nd July, 1974:

Morning:	9.00	Official Opening at K.N.U.T. Conference Room
	10.00	Coffee break
	10.30	(1) Statement on Environmental Science Education and SEPA
		(2) Discussion of Keynote Speech
	12.15	Lunch Break
Afternoon:	14.00	Brief statements by participants
	15.30	Coffee break
	15.45	(1) Conclusion of statements by participants
		(2) Exposition by the Environmental Science Education Committee - Lesotho

Tuesday, 23rd July, 1974

Morning:	9.00	(1) Exposition by the Science Curriculum Development Centre - Sierra Leone
		(2) Exposition by the University of Nairobi
	10.15	Coffee break
	10.30	(1) Exposition by Namutamba Pilot Project Director - Uganda
		(2) Exposition by Midwest Ministry of Education - Nigeria
	12.15	Lunch break
Afternoon:	14.00	Plenary Session:-
		(1) Comments by Prof. E.A. Yoloye - Director, International Centre in Educational Evaluation - University of Ibadan
		(2) Formation of working groups
	15.30	Coffee break
	15.45	Working groups

Wednesday, 24th July, 1974

Morning:	9.00	Working groups
	10.15	Coffee break
	10.30	Working groups
	12.15	Lunch break
Afternoon:	14.00	Working groups
	15.30	Coffee break
	15.45	Working groups

Thursday, 25th July, 1974

Morning:	9.00	Working groups
	12.15	Lunch break
Afternoon:	Free	

Friday, 26th July, 1974

Morning	9.00	Plenary session - Group reports	(subsequently changed
	10.30	Coffee Break	to enable group work
	10.45	Conclude reports by groups	to continue)
	12.15	Lunch break	
Afternoon:	14.00	Plenary session - formulation of recommendations.	

Saturday, 27th July, 1974

Morning:	9.00	Plenary session - approval of final recommendation and report
	11.30	Conclusion
Afternoon	Free	

Sunday 28th July, 1974: Participants leave.

Note: Meeting places will be as follows:

- Monday morning at Kenya National Union of Teachers Conference Room.
- Monday afternoon, Tuesday morning and afternoon at UNESCO - Bruce House.
- Wednesday and Thursday at the Kenya Institute of Education - Desai Road.
- Friday and Saturday at UNESCO - Bruce House.

WELCOMING ADDRESS BY HON. PHILIP MBAI, M.P., ASSISTANT MINISTER FOR EDUCATION

to the Joint UNESCO/UNICEF/SEPA Workshop on Environmental Science Education at the Kenya National Union of Teachers Building, Mfangano Street, on Monday, July 22, 1974, at 9.00 a.m.

It is my pleasant duty to welcome all the delegates to this Environmental Science Education Conference.

This meeting represents a precedent in the history of International co-operation. UNICEF and UNESCO are familiar to us all as established organisations committed to assisting the countries of the Third World to overcome the myriad of development problems currently facing them. Kenya, as indeed all countries represented at this meeting, has and is working co-operatively with these organisations in a variety of programmes to improve the well being and educational standards of her peoples. Kenya in fact is represented on the Governing Board of UNESCO. However, it is encouraging to see these two giants in International co-operation supporting an infant and African organisation in the field, namely SEPA.

SEPA, the Science Education Programme for Africa, has been in existence but a few years. Yet already it has established itself as a relevant and effective Pan-African institution in promoting innovative and truly African programmes in Education. At this stage it is perhaps worthwhile digressing a little for those not familiar with SEPA as an organisation.

The Science Education Programme for Africa came into being due to the efforts of the African Primary Science Programme, an American-based curriculum organisation. From its beginning this programme, through international workshops, consultancies and direct support to African institutions concerned with curriculum work, was of considerable help in catalysing change of the general climate within which curriculum change took place in Africa during the 'sixties. It also contributed to the development of African manpower and of curricular materials more relevant to the needs of primary school children in Africa. Many of our children and teachers in Africa are using books and films adapted from these original African Primary Science Programme materials. However, by the late 'sixties, many of the Africans who were involved with the African Primary Science Programme, with the support of the programme itself, felt the need that such a sensitive yet effective programme should come into the complete control of African hands. With this aim in mind SEPA, the Science Education Programme for Africa, was created. This aim has now been achieved. A skeleton Secretariat based in Accra, Ghana, is supported financially and with professional co-operation from the African member States and is responsible for the day to day programming of the organisation. An executive committee, drawn from SEPA's highest organ - the Representative Council - meets several times a year to oversee the work of the Secretariat. The Representative Council, consisting of two members from each of the 14 member States, meets biannually to set broad guidelines for the programme.

Briefly, SEPA's style of approaching its task of promoting excellence in Science Education in Africa is two-fold. Firstly, through exchange of experienced manpower and information between African countries it facilitates the development of the programmes of the member States. Secondly, having identified areas of priority in areas of science education in Africa, it initiates programmes to spearhead development in these areas. An example of this type of programme is the International Centre for Educational Evaluation at Ibadan, Nigeria, created through the joint efforts of SEPA and the University of Ibadan and supported by the Carnegie Corporation. This Centre provides basic research and manpower training facilities to the member States of SEPA.

Another such programme is the one for which we are gathered here this morning. Africa is faced with the problem, or rather conglomeration of problems, of how best to exploit here natural resources which, of course, is unseparable from the problems of the development of peoples. We in Africa are faced with a period of extremely rapid change, some of our own choice and some that are thrust upon us. How best to prepare future generations to not merely cope with these changes but to contribute confidently and positively to the development of our countries is the purpose of this workshop. To achieve this, this gathering has recognised that the focal point at which our efforts must be concentrated is the teacher and it has also recognised that an approach must be adopted that builds from the ordinary man's point of view. Africa has a long and distinguished history of living with her physical environment and adapting socially without bringing about those deleterious effects on man and his environment that we see in so many parts of the world. Yet we are forced to change faster and faster. To find solutions to these problems I welcome the delegates from Botswana, Ethiopia, The Gambia, Sierra Leone, Swaziland, Ghanal, Lesotho, Uganda, Somalia, Tanzania, Liberia and Zambia as well as the lecturers and students on whose shoulders the task will ultimately fall.

Good Luck in your deliberations. Thank you.

ADDRESS BY THE CHAIRMAN OF SEPA

Mr. Chairman, the Hon. Minister of Education, the Hon. Minister of Natural Resources, distinguished guests, ladies and gentlemen. It gives me great pleasure to address you rather briefly on the rationale behind the decision of the Science Education Programme for Africa (SEPA) to conduct this Workshop, jointly with the aid of UNICEF and UNESCO, on Environmental Science Education.

Since its inception at Freetown, Sierra Leone in February, 1970, SEPA has worked very closely with UNESCO and UNICEF in various ways, such as: seeking advice on planning strategies, requesting financial commitments for consultants at various workshops, and in pooling of professional resources for the launching of new programmes in Africa. This environmental science education workshop is one such programme, not forgetting the launching of PESA in West African francophone countries at a workshop which just ended in Dakar last week and the Rural Science Education workshops held here, in Nigeria and elsewhere a few years ago.

Strictly speaking, the activities of SEPA have been oriented toward the environment right from the beginning. As many of you here are aware of, SEPA is a continuation of the African Primary Science Programme (APSP) under African direction and responsibility. APSP differed from the traditional primary science taught at schools in three ways: Firstly, the discovery method of teaching was introduced in which African children were encouraged to find out things for themselves instead of the teacher telling them everything. Secondly, the content or subject matter taught was related to the African environment, and a curriculum was developed showing the relevance of the local environment in the learning process at school. Thirdly, great emphasis was placed on investigating locally available materials in the provision and construction of equipment and teaching aids for the classroom.

With this type of environmentally oriented background in developing primary science materials and methodology in African schools, SEPA is now launching a more intensive programme with emphasis on pre-service education of teachers. SEPA is concerned not merely with the production of science teachers, but with the training of teachers who can make sue of their local environment in the teaching of science in schools. The problems of modern living in Africa today concern the wise management of our natural resources for the benefit of future generations. The lack of conservation measures leading towards uncontrolled exploitation of our natural resources, unrestricted urbanisation and ineffective population control, are creating environmental stresses evident in our society now as pollution of the air we breath, the water we drink and the food we eat. Pollution problems are very complex and inter-related with various disciplines. The educationists, the scientists, geographers, agriculturalists or medical personnel, not one of these alone can tackle the pollution problem - an integrated approach is required.

Within the past decade various international bodies such as SCOPE (Scientific Committee for the Protection of the Environment), IUCN (International Union for the Conservation of Nature and Natural Resources), the EPA (Environmental Protection Agency of the USA), the MAB (Man and the Biosphere) Programme of UNESCO, and recently UNEP (United Nations Environmental Protection Agency) here in Nairobi have been directing themselves to pollution and conservation problems caused by man's impact on the global environment. At this point the nature of the environment must be emphasised! The environment is an enveloping concept covering the living part of the earth - the biosphere - and the non-living physical and chemical components of the earth. The biological component of this earth includes all living animals and plants; thus human beings play a very important role in the environment in their ability to manipulate the total environment for better or for worse! This unique position of man, as the only animal with a complete control over the environment, is his own undoing. Although man's civilising influences are a necessity to modern living, yet they are creating mismanagement problems resulting in an upset in the balance of nature.

In conclusion, ladies and gentlemen, SEPA has been conscious of the seriousness of environmental problems in Africa and elsewhere today. SEPA has a responsibility in creating and developing environmentally oriented programmes in education for our schools and colleges. Furthermore, SEPA realises that environmental education does not only include the scientific study of our local environment. Any programme we develop must relate intimately to the social and behavioural sciences. For SEPA hopes to create an environmentally conscious population in Africa in which our young minds of today, as future leaders of tomorrow, can assess the effects of their actions in promoting development plans, and in taking decisions about our natural resources that will not be detrimental for any future generations. Thank you.

DR. N.H. AYODELE COLE
Fourah Bay College
University of Sierra Leone.

STATEMENT BY MR. BRIAN JONES

(UNICEF REGIONAL DIRECTOR FOR EASTERN AFRICA)

People talk about today's concern with the environment as if it were something new.

For those of us who grew up in the West, with its obsession with machines and technology, and where progress was commonly thought of as a domination of nature, perhaps it is proper to speak of a rediscovery of the environment.

But in Africa the study of the environment has always been an educational imperative. I do not mean to say it has always figured as a part of the formal school curriculum. Unfortunately, it has not. But in traditional education - the transmission of skills and knowledge from generation to generation by the family, the tribe and the community - what we would today call "environmental studies" have always played a major role.

A Tanzanian friend of mine was recently watching a film of a geography lesson in a Tanzanian village school. It was a good geography lesson, starting with the drawing of a map of the village itself and its surroundings on the blackboard. My friend laughed. "When I went to school", he said, "I knew more about the geography of Australia than about the geography of my own country".

My friend had been the victim of an alien system of education transplanted to Africa lock, stock and barrel because it had worked elsewhere. The new emphasis on environmental studies in Africa's formal school systems is an important step in the process of restoring to African education the vital factor of "relevance" which we hear so much about all over the world today.

UNICEF's concern is to help countries meet the needs of their less fortunate children in such fields as health and nutrition. It is also concerned with helping countries prepare their children for active and useful lives. What have these concerns to do with environmental questions? A great deal, I should say.

In its early days, UNICEF was rather heavily involved in the transfer of certain types of modern technology to the developing countries. UNICEF supplied up-to-date equipment to hospitals and health centres; it purchased and shipped enormous quantities of newly-developed chemicals, vaccines and wonder-drugs for campaigns against malaria, tuberculosis, and other diseases. It equipped scores of modern dairy plants around the world. This transfer of technology has benefitted millions of children, but we are increasingly convinced that it is not the answer in itself to the needs of children in the developing countries. Local solutions must be found specifically adapted to local needs and conditions, and they must be developed by local people.

Take the matter of diseases, for example. Drugs are indispensable in curing many diseases, but prevention is always to be sought first, and prevention of disease is largely a matter of hygiene, sanitation and adequate nutrition.

Health and nutrition are basically environmental matters. They involve man's relation to soil, water, climate, pathogenic organisms, plants, animals - a whole host of ecological factors, with man's own labour and intelligence entering to a large degree into the equation, too. In the final analysis, progress in these fields is going to depend primarily on the efforts of village-level people who have been educated to a better understanding of their relationship with their natural environment.

Village people of the old days understood their relationship to nature at a level that enabled them to survive. Their relationship with their environment was a close one, but we should not sentimentalize it - their environment supported them, but they were frequently its victims, too. Your children and grandchildren, with the help of science, can understand their environment in a way that will enable them to leade healthy and prosperous lives.

I am pleased that UNICEF has been able to provide the funds which have ensured the participation of governmental representatives in this Environmental Science Education workshop, and to be one of its sponsors. Our policy in the field of education is to assist innovation projects aimed at making primary schooling more relevant to the life children will lead in their own communities, and I want to assure you that we will follow the deliberations and conclusions of your Workshop with the greatest practical interest.

EARO Regional Office for Eastern Africa
P O Box 44145
NAIROBI

July 19, 1974.

KEYNOTE ADDRESS BY HON. W.O. OMAMO, MINISTER FOR NATURAL RESOURCES (KENYA)

Mr. Minister, Distinguished Guests, Dedicated Officers of UNICEF/UNESCO, Ladies and Gentlemen.

I would like first of all to thank the organizers of this Workshop for having remembered me and decided to bestowe upon me the honour of delivering the Key Note speech.

Environmental Education is posed to become one of the catch words of the 'seventies. The last few years have seen an ever growing awareness that mankind is faced with the somewhat awesome task of Hobsons Choice. Apart from the stratosphere, atmosphere, biosphere and hydrosphere, a new baby sphere known as TECHNOSPHERE, has been born. The baby, TECHNOSPHERE, has grown very fast. Indeed, today Science and Technology offer mankind alternative possible futures. One of them is a future where the world will be rid of the evils of poverty, ignorance and disease. The other beckons to an exhausted earth, her natural resources depleted, her rivers, lakes even her air and soil, polluted and destroyed beyond redemption. The question is what to do in order to enhance the quality of human life while the Technosphere is expanding rapidly in all directions?

At the 1972 Stockholm Conference on Human Environment, mankind had for the first time a forum to have a critical look at the results of his many years of effort to control his environment. He said that "Man is the only animal capable of curing diseases caused by his own folly".

We in Africa have to identify and define our own environmental problems. Indeed for countless years the people of Africa lived in a state of remarkable harmony with their environment. Social structures and customs supported the modes population. Patterns of land utilisation including shifting cultivation, never seriously depleted the soil and left ample time for recovery. Technology, though deceptively simple, was very effective.

The bronze workers of Nigeria, the gold workers of Ghana, Africa's wood carvers, potters, musicians and dancers were artists with powerful skills. Africa had no primitive society per se.

The diaries of the Europeans who made early contact with Africa again and again indicate this. Benin is described by one such writer as far surpassing, in organisation and cleanliness -- Amsterdam and other cities in Europe the writer had known. The social organisations and structures of West, Central and East Africa impressed those early visitors with their extensiveness. Indeed it could be argued that their effectiveness contributed to Africa's subsequent period of exploitation.

Neither was Africa a static society resistant to innovation. The cultivation of the yam in West Africa, and of the sorghums and finger millets in East Africa, is comparable only perhaps to the development of corn in Central America, and rice in India. Indeed, Mr. Chairman, the ease with which other

crops have been accepted and exploited, the rolling development of city and empire states throughout Africa, all belie the picture of an unchanging continent before the advent of the Europeans.

Over the past three to four hundred years Africa has increasingly become part of a world community. Increasingly her problems have become inseparable from those of the rest of the world. Quite often there has been an overflow of problems from other continents into the African continent. But, Mr. Chairman, may I suggest to you that for the continent to be wholly dependent upon outside technology for the identification and solution of her problems would not only be short sighted but also suicidal, particularly in the area of social technology.

Fro example, during the colonial era, agricultural extension workers worked largely with the men in the community, yet in those communities the women played a vital role in farming operations. In similar ways, formal and informal educational structures ignored the customs and practices that held African communities in good stead for so long.

Mr. Chairman, I am not attempting to advocate a return to the 'golden era' of Africa or to ignore the current pressing development problems we are all familiar with and the possible solutions that modern technology has to offer us. Rather, I am pleading with you, Mr. Chairman, that our educational planners must realise that problems and their solutions are better appreciated when they are recognized by the people themselves.

Environmental education connotes a whole complex of relationships between an individual, his society, the physical environment and the constantly changing dynamic equilibrium between them. None of these factors can be ignored. The individual must be educated in a way that is sympathetic to his deep emotional and cognitive structures so that he remains confident in himself and his ability to intellectually solve his problems. He must be educated in a style and manner that is sympathetic to and reinforces the support he obtains from his immediate society and culture. A man alienated from his society is lost.

He must be educated so that his perception of his physical environment is deepened and his intellectual awareness of what is possible is broadened. Yet this must be achieved whilst maintaining a regard for the wholeness and subtle interplay between the individual, his society and his physical environment. Only then can there be the self confidence and intrinsic motivation that will enable our people to develop programmes of environmental renewal that successfully marry what they know to be good in their age long established practices with what is relevant and best in what modern science and technology has to offer.

In each and every part of the African continent, the problems will be different. In some parts it is a culture and life style where great herds of cattle strip the top soil leaving it exposed to the winds. In others the pressures of population have rendered sound traditional farming practices inadequate. There are areas of good land being rapidly depleted of its

forest reserves whilst neighbouring lands remain unsettled for want of irrigation schemes that could be applied. There is the ambivalent attitude towards our scenery and wildlife - one of our major natural resources. There are the problems raised by intensive plantation cash-cropping rendering a people incapable of feeding themselves. There are areas where traditional living habits or the unprepared introduction of modern technology like dams, lays a population open to the ravages of epidemic diseases. There are the problems of our rapidly growing cities with peoples alienated from their land, their culture and accustomed living patterns. Our peoples must be educated not merely to help them cope with these problems, but also to enable them to build a sane and self-renewing environment for themselves and future generations.

This is the task facing this workshop today. The industrialised nations now suffer "industrial pollution". African countries today have their plateful of other types of pollutants:-

- Soil degradation caused by soil erosion;
- overgrazing caused by overstocking;
- uneconomic crop and livestock management practices;
- endemic hunger and poverty resulting in malnutrition;
- the glimpses of festering slums due to faulty human settlement planning;
- the haunt by the Malthusian ghost of faster and faster growth of human population vis-a-vis the slaggish growth of the Gross Domestic Product;
- the inhuman political and social policies, including the apartheid of the Union of South Africa.

Since independence, Kenya has already lost through forest fires the following:-

- 2,304 hectares of plantation forests;
- 18,329 hectares of indigenous forests; and
- 27,900 hectares of grass and bush all valued at K£1.5 million.

Mr. Chairman, please believe me when I say that in Kenya today the most formidable foe in the destruction of the forest resources is man himself. In agriculture, it is also known that the greatest problem facing African farmers are the farmers themselves.

1) We need education that places special emphasis on the importance of the nation's renewable natural resources.
2) We need education that pays attention to non-renewable natural resources and putting them to the best use.
3) We need education that reminds the pupil that man is just a cog in the wheel of the mother earth.
4) We need education that would dramatise the old noble ideas that man is really the master of the earth - the salt of the earth according to the Holy Bible.
5) We need education that would constantly remind man of the nature's dynamic balance in the different ecosystems.

LIST OF PARTICIPANTS

COUNTRY REPRESENTATIVES

Botswana:

Mr. G.E.T. Makhunga (Senior Teacher)
Kgari Schele Secondary School
Private Bag 2
Molepolole - Botswana

Mrs. E. Mandisi Vanqa (Science Teacher)
Lobatse Secondary School
Private Bag 13
Lobatse - Botswana

Ethiopia:

Ato Mulugeta Asres (Instructor, Teacher Training Institute)
c/o Ato Ahmed Karrar
Science Specialist
Ministry of Education
Addis Ababa - Ethiopia

Ato Kedir Ibrahim
Science Curriculum Centre
Ministry of Education
Addis Ababa - Ethiopia

The Gambia:

Mr. Y.H.M. Jallow (Assistant Teacher)
c/o Chief Education Officer
Ministry of Education
Banjul - The Gambia

Mr. S.M.L. Kinteh (Science Lecturer, Yundum College)
c/o Chief Education Officer
Ministry of Education
Banjul - The Gambia

Ghana:

His Excellency S.M. Adu-Ampoma
(Ghana High Commissioner to Kenya)

Kenya:

Mr. D.M. Gatua (Teacher)
Kijabe High School
P O Kijabe - Kenya

Mr. C.R. Onyango (School Inspector)
Principal Education Officer's Office
P O Box 775
Kisumu - Kenya

Lesotho:

Mrs. M. Malahlela (Head Teacher)
Iketsetseng Private School
Maseru - Lesotho

Lesotho:	Mr. S.T. Thelejane University of Botswana, Lesotho & Swaziland Roma - Lesotho	(Senior Lecturer
Liberia	Mrs. J. Badio National Curriculum Co-ordinator Ministry of Education Monrovia - Liberia	
	Mr. Isaac Zawolo Rural Teacher Training Institute Kakata - Liberia	(Science Tutor)
Mauritius:	Mr. G. Edouardo (Science Tutor - Teacher Training College)	
Sierra Leone:	Dr. Magnus J. Cole Science Curriculum Development Centre Njala University College Private Mailbag Freetown - Sierra Leone	(Director)
	Mr. A.J.A. Pratt Freetown Teachers' College Bishops Court, Fourah Bay Road Freetown - Sierra Leone	(Lecturer)
Somalia:	Mr. I.M. Abyan Ministry of Education P O Box 24 Mogadiscio - Somalia	(Director)
	Mr. S.M. Aden Ministry of Education P O Box 24 Mogadiscio - Somalia	(Head of Curriculum Unit)
Swaziland:	Mr. E.C.N. Dludlu Ministry of Education Mbambane - Swaziland	(Inspector of Schools)
	Mr. H. Nkambule Ministry of Education Mbambane - Swaziland	
Tanzania:	Mr. C. Kazaura College of National Education P O Box 1411 Butimba, Mwanza - Tanzania	(T.T.C. Tutor)
	Mr. J.K. Ndeorano Institute of Education, University of Dar es Salaam P O Box 35091 Dar es Salaam - Tanzania	(Science Co-ordinator)

Uganda: Mr. D. Kiyimba (Director, Namutamba)
Namutamba Integrated Science Pilot Project
P O Box 332
Mityana - Uganda

Mr. J.M. Kateeba - (N.C.D.C. - Kampala)

Miss C.D. Namuddu - Lecturer, National Institute of Education)

Zambia: Mr. W.M.A. Chileshe (Curriculum Specialist, Ministry
P O Box RW91 of Education)
Lusaka - Zambia

CONSULTANTS

Dr. N.H. Ayodele Cole	-	University of Sierra Leone
Dr. Tamaini Mcharo	-	Serengeti Research Institute
Prof. C.I.O. Olaniyan	-	University of Lagos
Prof. E.A. Yoloye	-	University of Ibadan
Mr. A.J. Young	-	University of South Wales
Mr. R.M. Nyonyintono	-	Lecturer, Kenyatta University College
Dr. M.E. Kimball	-	The Ford Foundation
Dr. J.O. Perry	-	University of Nairobi
Mr. Paul N. Balyejusha	-	UNESCO, Kenya
Mr. Stanley Moss	-	British Council, Kenya
Mr. G.N. Sharma	-	UNESCO, Nigeria
Mr. K.T. Chimombe	-	African Social Studies Programme, Kenya
Mr. M. Mukoko	-	Kenya National Parks
Elizabeth O. Wangari	-	Kenya National Parks
Mr. Isaac Hunja	-	Ministry of Education, Kenya
Mrs. C. Shepard Perry	-	Texas Southern University

SERVICE STAFF

Mrs. Kupelian	-	UNICEF, Eastern Africa
Mr. M.B.R. Savage	-	Kenya Institute of Education
Dr. H.M. Dyasi	-	SEPA, Accra

SUPPORTING INTERNATIONAL ORGANISATIONS

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Science Education Programme for Africa.